2012 – 2013
M.TECH. AUTUMN (I SEMESTER) EXAMINATION
(COMPUTER ENGINEERING)
NUMERICAL & STATISTICAL TECHNIQUES (AM-661)

Max. Marks: 60
Duration: Three Hours

"Students governed by the old ordinance will be examined out of 75 marks and their obtained marks will be proportionately raised."

Note: Answer five questions by selecting at least two questions from each section. The normal distribution table is provided with the question paper.

SECTION – A

1. (a) Fit a curve of the form \( y = ax + b/x \) in least square sense to the data:
   \[
   \begin{align*}
   x &= 01 \\ y &= 21
   \end{align*}
   \]

(b) Approximate \( \frac{1}{1 + x^2} \) in least square sense by the function of the form
   \( a + bx + cx^2 \) in \(-1 \leq x \leq 1\).

2. (a) Obtain the first three non-zero terms of the solution by Taylor series for
   \[
   \frac{dy}{dx} = y + z + x,
   \]
   \[
   y(0) = 0
   \]
   \[
   \frac{d^2y}{dx^2} = y - x,
   \]
   \[
   z(0) = 1,
   \]
   \[
   z'(0) = -1
   \]
   Find \( z(0.2) \) and \( z'(0.2) \)

(b) Use Modified Euler’s method to calculate
   \( x(0.2) \) and \( y(0.2) \), given
   \[
   \frac{dx}{dt} = xy - z + x(0) = 0
   \]
   \[
   \frac{dy}{dt} = ty + 2x,
   \]
   \[
   y(0) = 1
   \]
   Choose \( h = 0.2 \)

3. (a) Use Runge-Kutta method of order 4 to calculate \( y'(0.2) \) for the initial value problem:
   \( y'' + y' + xy = 0 \), \( y(0) = 1 \), \( y'(0) = -1 \).

(b) Torsion on a rectangular bar subject to twisting is governed by
   \[
   \frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = -xy
   \]
   Given the condition \( T = 0 \) on the boundary. Find \( T \) over a cross section of a bar of size 9cm x 9cm by choosing \( h = 3 \) cm.

4. (a) Given \( \frac{\partial f}{\partial t} = 2 \frac{\partial^3 f}{\partial x^3} \), \( 0 \leq t \leq 1.0, \ 0 \leq x \leq 4 \)

   Initial conditions: \( f(x,0) = 50 (4-x) \), \( 0 < x \leq 4 \)

   Boundary conditions: \( f(0,t) = 0, \ 0 \leq t \leq 1.0 \)
   \( f(4,t) = 0, \ 0 \leq t \leq 1.0 \)

   Solve the above partial differential equation by Crank-Nicholson Scheme using \( h = 1 \).

   Contd....2,
Consider: \( \frac{\partial^2 f}{\partial t^2} = 4 \frac{\partial^2 f}{\partial x^2}, 0 \leq x \leq 5, \quad 0 \leq t \leq 1.5 \)
with \( f(x,0) = x(5-x), \quad 0 \leq x \leq 5 \)
\( \frac{\partial f}{\partial t}(x,0) = 0, \quad 0 \leq x \leq 5 \)
Solve numerically the above equation by choosing \( h=1 \).

SECTION – B

5. Suppose that the two-dimensional continuous random variable \((x, y)\) has joint pdf given by
\[ F(x,y) = x^2 + \frac{1}{3} xy, \quad 0 \leq x \leq 1; \quad 0 \leq y \leq 2 \]
\[ = 0, \quad \text{elsewhere}. \]
(a) Calculate the marginal probability distribution functions \( g(x) \) and \( h(y) \).
(b) Given \( B = \{x+y \geq 1\} \), Calculate \( P(B) \)
(c) Given \( A = \{x \geq \frac{1}{2}; \quad y \geq 1\} \), Calculate \( P(A|B) \)

6. (a) In a circuit the current \( I \) and the resistance \( R \) vary in some random way. \( I \) and \( R \) are independent continuous random variables with pdf's
\( I : g(i) = 4i^3, \quad 0 \leq i \leq 1 \) and 0, elsewhere
\( R : h(r) = \frac{r^2}{9}, \quad 0 \leq r \leq 3 \) and 0, elsewhere
Find the pdf of \( E = IR \)
(b) Suppose that the two-dimensional random variable \((x, y)\) is uniformly distributed over the region \( R = \{(x,y): 0 < y < n < 1\} \)
Calculate the correlation coefficient \( \rho \).

7. (a) \( X \) is exponentially distributed with parameter \( \alpha = 0.002 \). A sample of size 25, \( x_1, \ldots, x_{25} \) is chosen at random. Find \( P(400 < \bar{x} < 550) \) and \( P(M > 700) \) where \( M \) is the maximum of \( x_1, \ldots, x_{25} \).
(b) A manufacturer claims that only 5% of his products are defective. A random sample of 500 products contained 30 defectives. Test the claim of the manufacturer.

8. (a) Discuss the stochastic process \( x(t) \) involved in a random walk. Obtain the value of \( E(x(t)) \) and \( E(x^2(t)) \).
(b) A sample of size 5 is obtained from a random variable with distribution \( N(12, 4) \).
(i) What is the probability that the sample mean exceeds 14?
(ii) What is the probability that the minimum of the sample is less than 11?

Contd...
\[
(\tau \geq 2)T = n \cdot \frac{Z^2}{\sqrt{V}}
\]

Table (Continued)

\[
(x \leq z) = \int_{-\infty}^{x} \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}} dz
\]

Table 1. Values of the Standard Normal Distribution Function.
2012-2013
M.TECH. AUTUMN (I SEMESTER) EXAMINATION
(COMPUTER SCIENCE AND ENGINEERING)
SOFTWARE ENGINEERING-I
(CO-601)

Maximum Marks: 60
Duration: Three Hours

"Students governed by the old ordinances will be examined out of 75 marks and their obtained marks shall be proportionately raised."

Note: Answer all questions.
Make appropriate assumptions, if required.
Symbols and abbreviations have their conventional meanings.

1. (a) Identify the problem one would face, if he tries to develop a large software product without using software engineering principles. (5)
   (b) Explain a generic view of software engineering. (5)
   (c) List the advantages and disadvantages of Rapid Application Development (RAD) model. (5)

   OR
   (c') Elaborate the concept of WINWIN Spiral model. (5)

2. (a) Discuss the characteristics of team leaders. (5)
   (b) Differentiate the following software metrics: process, product and project. (5)
   (c) Make a technical note on empirical estimation structures. (5)

   OR

2'. (a) Which software team structure could you be selecting for high risk projects and why? (5)
   (b) Discuss the various measures of software quality. (5)
   (c) Explain in details the Defect Removal Efficiency (DRE). (5)

3. (a) Explain the requirement elicitation methods for software. (5)
   (b) List the characteristics of a good SRS and the attributes of a good design. (5)

   OR
   (b') What are the scopes and principles of software design? (5)
   (c) Define cohesion and coupling. List levels of cohesion and coupling in order of their strength. (5)

4. (a) What are the testing objectives and testing principles? (5)

   OR
   (a') What are the different levels of testing? Explain in details. (5)

contd... 2
(b) Draw the control flow graph, compute the cyclomatic complexity and write all the independent paths of the program given below:

```c
void main()
{
    int i, j, k;
    readin(i, j, k);
    if((i < j) || (j > k))
    {
        writeln("HELLO");
        if(j < k) {
            writeln("HI");
        }
        else { writeln("BYE"); }
    }
    else writeln("SORRY");
}
```

(c) Discuss the criteria for completion of testing.
2012 – 2013
M.TECH. AUTUMN (I SEMESTER) EXAMINATION
(COMPUTER SCIENCE & ENGINEERING)
SELECTED TOPICS IN COMPUTER SYSTEMS
(CO – 602)

Maximum Marks : 60
Duration : Three Hours

"Students governed by the old ordinances will be examined out of 75 marks and their obtained marks shall be proportionately raised."

Note: Answer any FIVE questions. Symbols and abbreviation have their conventional meanings. Assume suitably whenever required.

1. (a) Write the algorithm for bubble sort with early detection. Given an array A of 100 elements of which only last three are not in sorted order. What will be the ratio of computation time for sorting A with early detection to that without early detection.

(b) Give the complete specification of an abstract data type QUEUE to implement the FIFO functionality.

2. (a) Write the three step algorithm design approach. Explain the outcome of each step.

(b) Taken an example, explain the concept of Abstract Data Type.

3. (a) Discuss the “list of children” representation of ADT TREÆ

(b) Using the facility of variable argument list for function in C language, write an implementation of the function CREATE (V, T₁, T₂, …) for ADT TREÆ

4. (a) Convert the following ε-NFA to a DFA:

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<tr>
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<th>a</th>
<th>b</th>
<th>c</th>
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</thead>
<tbody>
<tr>
<td>ε</td>
<td>{q₀, r₀}</td>
<td>φ</td>
<td>{q₀}</td>
</tr>
<tr>
<td>q₀</td>
<td>φ</td>
<td>{p₀}</td>
<td>{r₀}</td>
</tr>
</tbody>
</table>

(b) Write ζ(q₀, w) and L(A), where A can be:

(i) a DFA,   (ii) an NFA,   (iii) an ε-NFA

5. (a) Write the statement of pumping lemma, and prove that the language \{O^n | n is a perfect square\} is not a regular language.

(b) Give the formal definition of a context free grammar. Design a CFG for \{O^n 1^n | n ≥ 1\}. Give left-most and right-most derivations for 01, 0011, 001.

Contd…..2
6. (a) For the readers-writers problem, explain:
   (i) What are the shared objects for the reader and for the writer?
   (ii) How many critical sections are needed in reader process and in writer process?
   (iii) How many readers and / or writers can simultaneously access the shared data.
   (iv) Write the code in C for both the processes.

   (b) What do you mean by scheduling in general? Discuss the STF with burst-time prediction.

7. (a) Write down the phases of a computer and discuss each phase briefly. In which phase is the design of a parser needed?

   (b) Discuss briefly the different techniques for designing parsers.
Maximum Marks: 60
Duration: Three Hours

"Students governed by the old ordinance will be examined out of 75 marks and their marks shall be proportionately raised"

1. Assume a suitable data, if not given.
2. Acronyms have their usual meanings.

Q1 (a) What are the characteristics of wireless links? With the help of suitable diagrams, discuss hidden terminal problem and fading.

(b) (i) Consider Code-Division Multiple Access (CDMA) for a single sender who is assigned an M-bit code $(1, -1, 1, -1, 1, -1, -1)$, where $M=8$. Assume that there are two data bits $d_0 = -1$, $d_1 = 1$ to be sent in time slots 0 and time slot 1, respectively. Sketch the channel output at the sender side as well as at the receiver side.

(ii) Now consider that there are two sender-receiver pairs: $(S_1, R_1)$ and $(S_2, R_2)$. The first pair is allocated a code $(1, 1, 1, -1, 1, -1, -1, -1)$, and the second pair is allocated a code $(1, -1, 1, 1, 1, -1, 1, 1)$. Sketch the channel outputs at the sender side and at the receiver side. Write all intermediate steps and expressions used.

OR

1' (a) What are the impacts of wireless nature of links and the mobility, on higher layer protocols, for example, TCP and UDP? Describe the approaches to deal with the problems arising due to TCP’s congestion control response in a wireless setting.

(b) What is meant by a handoff in GSM? With the help of suitable diagrams, describe the steps involved when a base station does decide to handoff a mobile user. What happens when the mobile moves to a base station (BS) that is associated with a different MSC than the old BS, and what happens when this inter-MSC handoff occurs more than once?

Q2 (a) Suppose an 802.11b station is configured to always reserve the channel with the RTS/CTS sequence. Suppose this station suddenly wants to transmit 1000 bytes of data, and all other stations are idle at this time. As a function of SIFS and
DIFS, and ignoring propagation delay and assuming no bit errors, calculate the
time required to transmit the frame and receive the acknowledgement.

(b) Suppose there are two ISPs providing Wi-Fi access in a particular café, with each
ISP operating its own AP and having its own IP address block.

(i) Further suppose that by accident, each ISP has configured its AP to
operate over channel 11. Will the 802.11 protocol completely
breakdown in this situation? Discuss what happens when two stations,
each associated with a different ISP, attempt to transmit at the same
time.

(ii) Now suppose that one AP operates over channel 1 and other over
channel 11.

Q3 (a) What are the elements of mobile network architecture? With the help of suitable
diagrams, describe in detail the indirect and direct routing to a mobile node.

(b) Consider an indirect routing from a correspondent to a mobile user. Suppose that
the correspondent is also mobile. Sketch the network layer infrastructure that
would be needed to route the datagram from the correspondent to the mobile user,
and from the mobile user to the now mobile correspondent. Use indirect routing.

OR

3' (a) Describe agent discovery, registration with the home agent, and indirect routing
of datagrams in case of Mobile IP.

(b) Consider two mobile nodes in a foreign network having a foreign agent. Is it
possible for the two mobile nodes to use the same care-of-address in Mobile IP?
Explain your answer.

(c) In Mobile IP, what effect will mobility have on end-to-end delays of datagrams
between the source and destination?

Q4 (a) How jitter can be removed at the receiver for audio? Describe two playout
strategies: fixed playout delay, and adaptive playout delay.

(b) Consider the adaptive playout delay scheme to estimate the network delays. Let
$\delta_i$ be an estimate of the average network delay upon reception of the $i$th packet,
which is governed by the following expression.

$$\delta_i = (1-u)d_{i-1} + u(r_i - t_i)$$

where, $t_i$ is the timestamp of the $i$th packet (i.e. the time the packet was generated
by the sender), $r_i$ is the time packet $i$ is received by the receiver, and $p_i$ is the
time the packet is played at the receiver. Suppose that $u = 0.1$. Let $r_i - t_i$ be the
most recent sample delay, let $r_2 - t_2$ be the next most recent sample delay, and so on.

(i) For a given audio application, suppose four packets have arrived at the receiver with sample delays $r_1 - t_1$, $r_3 - t_3$, $r_2 - t_2$, and $r_1 - t_1$. Express the estimate of the delay $d$ in terms of the four samples.

(ii) Generalize your formula for the $n$ sample delays.

OR

4' (a) With the help of an appropriate diagram, describe setting up a call to a known IP address in case of Session Initiation Protocol (SIP). With the help of a suitable example, describe how name translation is carried out for a voice-over-IP session using SIP.

(b) Consider two forward error correction (FEC) schemes for Internet phone. The first scheme sends a redundant encoded chunk after every $n$ chunks. The second scheme sends a lower resolution audio stream as the redundant information. Suppose the first scheme generates a redundant chunk for every four original chunks. Suppose the second scheme uses a low-bit rate encoding whose transmission rate is 25% of the transmission rate of the nominal stream.

(i) How much additional bandwidth does each scheme require? How much playback delay does each scheme add?

(ii) How do the two schemes perform if the first packet is lost in every group of five packets? Which scheme will have better audio quality?

(iii) How do the two schemes perform if the first packet is lost in every group of two packets? Which scheme will have better audio quality?

Q5 (a) What do you understand by policing? What are the parameters used for policing? Discuss how one can combine leaky bucket with weighted fair queuing for provable maximum delay in a queue.

(b) Describe the key features of Intserv architecture. What are the difficulties associated with the Intserv model? How these difficulties are addressed in case of Diffserv model.
M. TECH (AUTUMN I SEMESTER) EXAMINATION
(COMPUTER ENGINEERING)
WEB MINING AND SEARCHING (CO-616)

MAXIMUM MARKS: 60
DURATION: THREE HOURS

Students governed by old ordinances will be examined out of 75 marks and their obtained marks shall be proportionally raised.

NOTE: Attempt All Questions. Make relevant assumptions wherever required.

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<tbody>
<tr>
<td>1</td>
<td>Attempt any two parts.</td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td>What is knowledge discovery in databases (KDD)? Explain each of its steps. Also differentiate between data mining, database and data-warehousing.</td>
<td>6</td>
</tr>
<tr>
<td>(b)</td>
<td>On what kind of data, data mining can be performed? Also discuss major issues involved in data mining.</td>
<td>6</td>
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<td>(c)</td>
<td>What is data transformation? Discuss any three methods for data transformation.</td>
<td>6</td>
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<tr>
<td>2</td>
<td>Attempt any two parts.</td>
<td></td>
</tr>
<tr>
<td>(a)</td>
<td>Why a separate data-warehouse is needed in data-warehousing? Why data-warehouse is built on a multi-dimensional model?</td>
<td>6</td>
</tr>
<tr>
<td>(b)</td>
<td>Write and explain the a-priori algorithm. Find all the frequent item-sets for the following transaction database.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>TID</td>
<td>Items Bought</td>
</tr>
<tr>
<td></td>
<td>T1</td>
<td>{K,A,D,B}</td>
</tr>
<tr>
<td></td>
<td>T2</td>
<td>{D,A,C,B,E}</td>
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<td></td>
<td>T3</td>
<td>{C,A,B,E}</td>
</tr>
<tr>
<td></td>
<td>T4</td>
<td>{B,A,D}</td>
</tr>
<tr>
<td>(c)</td>
<td>Explain how FP-growth is better than a-priori algorithm. Also find the frequent item-sets for the transaction database given in 2(b).</td>
<td>6</td>
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<td>3</td>
<td>Attempt any two parts.</td>
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</tr>
<tr>
<td>(a)</td>
<td>Differentiate between clustering and classification. Discuss different parameters used for evaluation of a classification method.</td>
<td>6</td>
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<tr>
<td>(b)</td>
<td>Briefly explain the Information Gain method used for attribute selection in decision tree classification. For the following data, select the best splitting attribute using Information Gain.</td>
<td>6</td>
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<th>credit_rating</th>
<th>buys_computer</th>
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</thead>
<tbody>
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<td>fair</td>
<td>no</td>
</tr>
<tr>
<td>&lt;=30</td>
<td>high</td>
<td>no</td>
<td>excellent</td>
<td>no</td>
</tr>
<tr>
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<td>excellent</td>
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<tr>
<td>&gt;40</td>
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<td>no</td>
<td>excellent</td>
<td>yes</td>
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<td>&gt;40</td>
<td>low</td>
<td>yes</td>
<td>excellent</td>
<td>yes</td>
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<tr>
<td>&gt;40</td>
<td>low</td>
<td>yes</td>
<td>excellent</td>
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<td>31...40</td>
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<tr>
<td>(c)</td>
<td>Briefly outline the steps involved in k-mean clustering algorithm. Also discuss its strength and weaknesses.</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Attempt any two parts.</td>
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<tr>
<td>(a)</td>
<td>What is the structure of world wide web? Explain.</td>
<td>6</td>
</tr>
<tr>
<td>(b)</td>
<td>Explain the steps involved in text preprocessing in an Information Retrieval system.</td>
<td>6</td>
</tr>
<tr>
<td>(c)</td>
<td>Explain the model on which PageRank algorithm is based. Also explain the PageRank algorithm with a suitable example. What are its limitations?</td>
<td>6</td>
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<tr>
<td>5</td>
<td>Attempt any two parts.</td>
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<tr>
<td>(a)</td>
<td>Explain the working of a basic crawler using a suitable diagram.</td>
<td>6</td>
</tr>
<tr>
<td>(b)</td>
<td>What are focused crawlers? Explain a method to implement a simple focused crawler.</td>
<td>6</td>
</tr>
<tr>
<td>(c)</td>
<td>What type of data is used in web usage mining? Also briefly explain the use of web usage mining in three applications.</td>
<td>6</td>
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</table>