B.TECH. WINTER (IV SEMESTER) EXAMINATION
(COMPUTER ENGINEERING)
(NUM. ANALYSIS, TRANSFORMS & PROBABILITY)
(AM-262)
Credits : 04

Maximum Marks: 60
Duration: Three Hours

Note: Answer all questions.
Programmable calculators are not allowed.

1. (a) Find the Laplace transform of \( \frac{\sin at}{t} \). Does the Laplace transform of \( \frac{\cos at}{t} \) exist?
   [04]
   
   (b) State convolution theorem. Find \( L^{-1}\left(\frac{1}{s(s+a)(s-a)}\right) \) by convolution theorem.
   [06]
   
   OR
   
   (b') Solve the initial value problem by Laplace method
   \( (D^2 + a^2)x = \alpha \sin (\omega t + \phi), \quad x(0) = 0 = x'(0) \).
   [06]

   (c) An alternating voltage 250 sin 100t applied at \( t = 0 \) to a circuit with an inductance
   50mH, capacitance 400\mu F and resistance 10\Omega. Find the current \( I \) at time \( t \) second
   if the initial current and charge are zero.
   [05]

2. (a) Find the interpolating polynomial of degree two approximating the function
   \( y = e^x \) using Lagrange's interpolation. Hence determine the value of \( y(2.7) \).
   [06]
   
   Given:

   \[
   \begin{array}{|c|c|c|c|}
   \hline
   x & 2.0 & 2.5 & 3.0 \\
   y - \ell_n(x) & 0.69315 & 0.91629 & 1.09861 \\
   \hline
   \end{array}
   \]

   (b) Find the solution of the system of linear equations
   \[
   \begin{align*}
   7x + 52y + 13z &= -104 \\
   83x + 11y - 4z &= 95 \\
   3x + 8y + 29z &= 71
   \end{align*}
   \]
   Using Gauss-Seidel method with three iterations.
   [05]

   (c) Find the real root of the equation
   \[
   x - \frac{x^3}{3} + \frac{x^5}{10} - \frac{x^7}{42} + \frac{x^9}{216} - \ldots = 0.4431
   \]
   Correct to four decimal places by general iteration method.
   [04]

3. (a) Compute the values of \( I = \int_0^1 \frac{dx}{1+x^t} \) by using trapezoidal rule with \( h = 0.125 \).
   [08]
   
   Obtain a better estimate by Simpson's 1/3 rule.

   Contd....2
(b) Evaluate \( \int_1^2 \frac{2x}{1 + x^4} \, dx \) using 2-point and 3-point Gauss Quadrature formula. Also discuss the error in both case.

OR

(b') Given initial value problem \( y' = 3x + \frac{1}{2}y \) with initial condition \( y(0) = 1 \). Calculate \( y \) at \( x = 0.5 \) by Runge-Kutta method of order 4 with \( h = 0.5 \). Also discuss the order of convergence.

4. (a) (i) Define conditional probability for two events \( A \) and \( B \), \( P(A) = 0.5 \), \( P(B) = 0.6 \), \( P(A \cap B) = 0.8 \). Find \( P(A|B) \) and \( P(B|A) \).

(ii) If \( A \), \( B \) and \( C \) are mutually independent events, then show that \( (A \cup B) \) and \( C \) are independent events.

(b) An experiment consists of three independent tosses of a fair coin.

Let
\[ X = \text{the number of heads} \]
\[ Y = \text{the number of head runs} \]
\[ Z = \text{the length of head runs} \]

A head runs being defined as consecutive occurrence of at least two heads and it's length is defined as the number of heads occurring together in 3-tosses of coin. Find the probability of

(i) \( X \)

(ii) \( Y \)

(iii) \( Z \).

Construct the probability distribution table and draw their probability chart.

OR

(b') (i) A continuous random variable \( x \) has the probability density function
\[ f(x) = \begin{cases} \frac{a - bx}{2a}, & 0 \leq x \leq 1 \\ 0, & \text{elsewhere} \end{cases} \]
If the mean of the distribution is \( 1/3 \), then find the values of \( a \) and \( b \).

(ii) A target is to be destroyed in a bombing exercise. There is 75% chance that any one bomb will strike the target. Assume that two direct hits are required to destroy the target completely. How many bombs must be dropped in order that the chance of destroying the target is \( \geq 99\% \)?

(c) State main characteristics of Normal probability curve. If \( X \sim N(\mu, \sigma^2_1) \) and \( Y \sim N(\mu, \sigma^2_2) \), then plot the curve for \( \sigma_1 < \sigma_2 \), where the symbols have their usual meanings.
1. (a) Answer any FOUR of the following:

(I) Give two reasons why the set of odd integers under addition is not a group.

(ii) Consider the equation $x^2 - 4x + 3 = 0$. Find the solutions in $\mathbb{Z}_7$ and $\mathbb{Z}_{12}$.

(iii) The set $\mathbb{Z}_n = \{0, 1, 2, \ldots, n-1\}$ under addition and multiplication modulo $n$ is a commutative ring with unity. Find the set of units of $\mathbb{Z}_7$ and $\mathbb{Z}_{10}$.

(iv) Let $U(n)$ be the set of all positive integers less than $n$ and relatively prime to $n$, show that $U(10)$ is a group under multiplication modulo 10.

(v) Make one change in the first nine digits of the ISBN 0-183-47381-7 so that the check digit will indicate an error.

(vi) Suppose that (approximately) 10,000 customer account records must be stored and processed. The company's computer is capable of searching a list of 100 items in an acceptable amount of time. Determine to which list the customer account number 2473871 should be attached.

(b) (i) For natural numbers $a$ and $b$, define $a R b$ if $a^2 + b$ is even. Prove that $R$ is an equivalence relation on natural numbers.

(ii) Let $R$ be the set of all real numbers and let $a * b = a + b + 2$. Determine whether the set $(\mathbb{R}, *)$ is a group. If it is a group determine if it is Abelian. Specify the identity element and the inverse element of $a \in R$.

2. (a) (i) Show that the no. of vertices of odd degree in a graph $G$ is always even. 

(ii) Define cut point and Bridges with examples.

(iii) Define the incidence matrix of a graph. If $G$ is disconnected and consists of two components, then find the form of incidence matrix.

(iv) Define a complete Bipartite graph and give an example.
3. (a) Prove that
\[ e+1 C_e = e C_{e-1} + e C_e \]

(b) Solve the recurrence relation
\[ a_n - 6a_{n-1} + 8a_{n-2} - 3^n = 0 \]
with \( a_0 = 0 \) and \( a_1 = 1 \). [06]

(c) Use generating function to solve the recurrence relation
\[ a_n - 9a_{n-1} + 26a_{n-2} - 24a_{n-3} = 0 \]
for \( n \geq 3 \) with \( a_0 = 0 \), \( a_1 = 1 \), and \( a_2 = 10 \). [06]
4. (a) The Mapple Store sells Mapple Computers and printers. The computers are shipped in 12-cubic-foot boxes and printers in 8-cubic-foot boxes. The Mapple store estimates that at least 30 computers can be sold each month and that the number of computers sold will be at least 50% more than the number of printers. The computer cost the store $1000 each and are sold for a profit of $1000. The printers cost $300 each and are sold for a profit of $350. The store has a storeroom that can hold 1000 cubic feet and can spend $70,000 each month on computers and printers. Formulate an LPP and solve graphically to find how many computers and how many printers should be sold each month to maximize profit? What is the maximum profit?

(b) Solve the following LPP using Simplex Method

Min \[ Z = 15/2 x_1 - 3x_2 \] subject to the constraints

\[ 3x_1 - x_2 - x_3 \geq 3 \]
\[ x_1 - x_2 + x_3 \geq 0 \]
\[ x_1, x_2, x_3 \geq 0 \]

(c) Obtain the dual of the LPP

Min \[ Z = x_1 + x_2 + x_3 \] subject to the constraints

\[ x_1 - 3x_2 + 4x_3 \leq 5 \]
\[ x_1 - 2x_2 \leq 3 \]
\[ 2x_2 - x_3 \geq 4 \]
\[ x_1, x_2, x_3 \geq 0 \] and \( x_3 \) is unrestricted.
2013-2014
B.TECH. WINTER (IV SEMESTER) EXAMINATION
(COMPUTER ENGINEERING)
(DISCRETE STRUCTURE)
(CO-205)
Credits: 04

Maximum Marks: 60
Duration: Three Hours

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

1. (a) Answer any FOUR of the following:

   (i) Give two reasons why the set of odd integers under addition is not a group.

   (ii) Consider the equation \( x^2 - 4x + 3 = 0 \). Find the solutions in \( \mathbb{Z}_{11} \) and \( \mathbb{Z}_{12} \).

   (iii) The set \( \mathbb{Z}_n = \{0, 1, 2, \ldots, n - 1\} \) under addition and multiplication modulo \( n \) is a commutative ring with unity. Find the set of units of \( \mathbb{Z}_7 \) and \( \mathbb{Z}_{10} \).

   (iv) Let \( U(n) \) be the set of all positive integers less than \( n \) and relatively prime to \( n \), show that \( U(10) \) is a group under multiplication modulo 10.

   (v) Make one change in the first nine digits of the ISBN 0-183-47381-7 so that the check digit will indicate an error.

   (vi) Suppose that (approximately) 10,000 customer account records must be stored and processed. The company’s computer is capable of searching a list of 100 items in an acceptable amount of time. Determine to which list the customer account number 2473871 should be attached.

(b) (i) For natural numbers \( a \) and \( b \), define \( a \equiv b \mod n \) if \( a^2 + b \) is even. Prove that \( \equiv \) is an equivalence relation on natural numbers.

(ii) Let \( R \) be the set of all real numbers and let \( a \times b = a + b + 2 \).

Determine whether the set \((R, \times)\) is a group. If it is a group determine if it is Abelian. Specify the identity element and the inverse element of \( a \in R \).

2. (a) (i) Show that the no. of vertices of odd degree in a graph \( G \) is always even.

(ii) Define cut point and Bridges with examples.

(iii) Define the incidence matrix of a graph. If \( G \) is disconnected and consist of two components, then find the form of incidence matrix.

(iv) Define a complete Bipartite graph and give an example.

Contd.....2
(b) Find the shortest route from the origin $O$ to the destination $T$ with the help of Dijkstra's Algorithm for the following weighted graph. Show the intermediate result of computation.

(b') Use Ford and Fulkerson's labeling algorithm to find a maximum flow for the given network. Each edge is labeled with its maximum capacity.

3. (a) Prove that

$$n^2 C_n = n^2 C_{n-1} + C_{n}$$

(b) Solve the recurrence relation $a_n - 6a_{n-1} + 8a_{n-2} - 3^n$, where $a_0 = 3$ and $a_1 = 7$.

(c) Use Generating function to solve the recurrence relation

$$a_n - 9a_{n-1} + 26a_{n-2} - 24a_{n-3} = 0$$

for $n \geq 3$ with $a_0 = 0$, $a_1 = 1$ and $a_2 = 10$.

Contd....3
4. (a) The Mapple Store sells Mapple Computers and printers. The computers are
stripped in 12-cubic-foot boxes and printers in 8-cubic-foot boxes. The Mapple
store estimates that at least 30 computers can be sold each month and that the
number of computers sold will be at least 50% more than the number of printers.
The computer costs the store $1000 each and are sold for a profit of $1000. The
printers cost $300 each and are sold for a profit of $350. The store has a
storeroom that can hold 1600 cubic feet and can spend $70,000 each month on
computers and printers. Formulate an LPP and solve graphically to find how
many computers and how many printers should be sold each month to maximize
profit? What is the maximum profit?

(b) Solve the following LPP using Simplex Method.
\[
\text{Min } Z = 15/2 x_1 - 3x_2 \text{ subject to the constraints }
\]
\[
3x_1 - x_1 - x_3 \geq 3 \\
x_1 - x_2 + x_3 = 2 \\
x_1, x_2, x_3 \geq 0
\]

(c) Obtain the dual of the LPP
\[
\text{Min } Z = x_1 + x_2 - x_3 \text{ subject to the constraints }
\]
\[
x_1 - 3x_2 + 4x_3 = 5 \\
x_1 - 2x_1 \leq 3 \\
2x_2 - x_3 \geq 4
\]
\text{x_1, x_2, x_3 \geq 0 and x_3 is unrestricted.
2013-14
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
COMPUTER ARCHITECTURE
CO-208

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) A digital computer has a memory unit with 24 bits per word. The instruction set consists of 190 different operations. Each instruction is stored in one word of memory and consists of an operation-code part and an address part.
(i) How many bits are needed for the operation code?
(ii) How many bits are left for the address part of the instruction?
(iii) How many words can exactly be accommodated in the memory unit?
(iv) Exactly what in decimal is the largest signed fixed-point binary number that can be stored in one word of memory? [07]

1(b) Design a simple computer that runs just the following 3 instructions: [08]

<table>
<thead>
<tr>
<th>Operation Code</th>
<th>Mnemonic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000001</td>
<td>MOV R</td>
<td>Move R to A</td>
</tr>
<tr>
<td>00000010</td>
<td>LDI OPRD</td>
<td>Load OPRD into A</td>
</tr>
<tr>
<td>00000011</td>
<td>LDA ADRS</td>
<td>Load operand specified by ADRS into A</td>
</tr>
</tbody>
</table>

2(a) With the main memory of size 512k x 16, a 3-way set associative mapping is to be carried out for the cache of dimensions 128 x 16. Find out the number of bits in each word of the cache. [07]

2(b) For a 20 bit addressing space, we wish to design overlapping memories of 8k and 2k [08]

co...
in such a way that the starting address of 8k memory is 62000 H and its last address coincides with the last address of the 2k memory. Design such a system and explain its working.

OR

2'(a) A 16 MB virtual address format has 16 segments of 256 pages each, wherein each word is 8 bits long. Correspondingly, find out the number of blocks in a 256 kB physical address format.

2'(b) Design a 4-bit accumulator with the following list of operations:

<table>
<thead>
<tr>
<th>Control Variable</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( p_1 )</td>
<td>Add</td>
</tr>
<tr>
<td>( p_2 )</td>
<td>Clear</td>
</tr>
<tr>
<td>( p_3 )</td>
<td>Complement</td>
</tr>
<tr>
<td>( p_4 )</td>
<td>AND</td>
</tr>
<tr>
<td>( p_5 )</td>
<td>OR</td>
</tr>
<tr>
<td>( p_6 )</td>
<td>Exclusive-OR</td>
</tr>
<tr>
<td>( p_7 )</td>
<td>Shift-right</td>
</tr>
<tr>
<td>( p_8 )</td>
<td>Shift-left</td>
</tr>
<tr>
<td>( p_9 )</td>
<td>Increment</td>
</tr>
<tr>
<td>( p_{10} )</td>
<td>Check for Zero</td>
</tr>
</tbody>
</table>

3(a) A Control State Diagram is given below. Design the Hardwired control using minimum number of T-Flip Flops.

3(b) Design a PLA controller for an arithmetic circuit that multiplies two fixed-point binary numbers in sign-magnitude representation.
3'(a) Design the hardwired control specified by the state diagram given below. Use the one flip-flop per state method. Draw the logic diagram using gates and D flip-flops.

3'(b) The flow chart given below carries out multiplication by successive addition. The multiplier and multiplicand are stored in registers \( R_1 \) and \( R_2 \) respectively. The product gets stored in register \( R_2 \). Write down the symbolic and binary microprograms corresponding to this flow chart. Use a generic microprogram control unit having a \( 64 \times 26 \) control memory.

4(a) What is the Node Fault Tolerance of an interconnection network? Find out the Node Fault Tolerance of the following networks, each with \( n \) nodes.

- (i) Fully connected Network
- (ii) Linear Array
- (iii) Ring
- (iv) Hypercube
- (v) 2-D Mesh

4(b) How is the floating-point addition/subtraction different from its fixed-point equivalent? Design and describe an Arithmetic Pipeline for carrying out floating-point addition and subtraction.
2013-14
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
SOFTWARE ENGINEERING
CO209/CO302

Maximum Marks: 60
Credits: 04/0.5
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)  Spiral model of software development is suited for which kind of project. Explain. [7.5]

1(b)  For each of followings, discuss whether you'll prefer doing them in prototyping model - i) Thorough testing of prototype ii) Increasing effort to deal with requirement changes during design and coding. [7.5]

OR

1'(a)  Compare component based software development using COITS component and custom built software development. [7.5]

1'(b)  For each of followings, describe whether you'll prefer doing them - i) Saving budget with reduction in coding effort at the expense of code quality. ii) Deploying more persons to expedite a delayed project. [7.5]

2(a)  Consider a project whose size is estimated at 30 KLOC. Use COCOMO model to estimate the effort required in developing the project. Assume nominal values for different cost drivers. Assume that project belongs to embedded category. Also estimate the duration of the project. [7.5]

2(b)  List the characteristics of egoless team structure. [7.5]

OR

2'(a)  Construct Data Flow Diagram (DFD) for course registration process in your engineering college. [7.5]

2'(b)  Discuss as to how a high quality SRS reduces cost of development. [7.5]

3(a)  Describe factors which increase and decrease coupling between modules. [7.5]

3(b)  Give diagrams representing followings in structure chart - i) Input Module ii) Output Module iii) Coordinate Module iv) Transform Module v) Compute Module. [7.5]

4(a)  Take suitable example to describe following coding errors - i) Buffer Overflow ii) Off-by-one. [7.5]

4(b)  Consider a program which is taking a list of sorted integers as input and searches a given item using binary search algorithm. Form equivalence classes on input and generate test cases on the basis of that. [7.5]