Maximum Marks: 60  
Credits: 04  
Duration: Two Hours

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

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Evaluate the following transforms:</td>
<td>CO-1</td>
</tr>
<tr>
<td></td>
<td>(i) $L\left[ \frac{e^t - \cos bt}{t} + t^2 u(t - 3) \right]$.</td>
<td>[08]</td>
</tr>
<tr>
<td></td>
<td>(ii) $L^{-1}\left[ \frac{1}{(s^2 + 1)(s^2 + 4)} \right]$ (by Convolution theorem)</td>
<td></td>
</tr>
<tr>
<td>1(b)</td>
<td>Using Laplace transform, find the solution of initial value problem (IVP):</td>
<td>[07]</td>
</tr>
<tr>
<td></td>
<td>[ \frac{dy}{dt} + 2y + \int_0^t y , dt = \sin t \quad \text{; \quad } y(0) = 0, \quad y'(0) = 1. ]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>1(b')</td>
<td>Express the following function $f(t)$ in terms of unit step function and hence obtain the Laplace transform:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ f(t) = \begin{cases} 1 &amp; \text{; \quad } 0 \leq t \leq a \ 2 &amp; \text{; \quad } a \leq t \leq 2a \ 3 &amp; \text{; \quad } 2a \leq t \leq 3a, \quad \text{and so on} \end{cases} ]</td>
<td></td>
</tr>
</tbody>
</table>

Contd... 2.
2(a) Solve the system of equations by Gaussian-Elimination method:

\[
\begin{align*}
2x + 2y + z + 2u &= 7 \\
x - 2y - u &= 2 \\
3x - y - 2z - u &= 3 \\
x - 2u &= 0
\end{align*}
\]

2(b) Locate and correct the error in the following table of values:

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>3010</td>
<td>3424</td>
<td>3802</td>
<td>4105</td>
<td>4472</td>
<td>4771</td>
<td>5051</td>
<td>5315</td>
</tr>
</tbody>
</table>

OR

2(b') Given the set of tabulated points (-1, 3), (0, -6), (3, 39), (6, 822) and (7, 1611). Find the polynomial by using Newton’s divided-difference interpolation formula. Also find the value of \( y \) when \( x = 2 \).

3(a) Find the approximate value of

\[
\int_0 ^1 \frac{1}{1 + x^2} \, dx \quad \text{with} \quad h = \frac{1}{6}
\]

by using Weddle’s rule.

3(b) Use the Runge-Kutta fourth order formula to find \( y(0.2) \) with \( h = 0.1 \) for the initial value problem:

\[
10 \frac{dy}{dx} = x^2 + y^2 \quad : \quad y(0) = 1
\]

OR

3(b') Solve, by finite difference method, the boundary value problem:

\[
y'' - 64y + 10 = 0 \quad ; \quad y(0) = y(1) = 0 \quad \text{with} \quad h = \frac{1}{3}
\]

4(a)(i) A, B, C can hit a target with probabilities \( \frac{3}{5}, \frac{2}{5}, \frac{3}{4} \) respectively. Determine the probability that at least two shots are hit.

(ii) In a bolt factory, machines A, B and C manufacture respectively 25\%, 35\% and 40\% of the total. Their respective output are 5\%, 4\% and 2\% of defective bolts. A bolt is drawn at random from the product and is found to be defective. What is the probability that it was manufactured by machine B?
4(b) Let $X$ be a continuous random variable with pdf given by:

$$f(x) = \begin{cases} 
ax; & 0 \leq x \leq 1, \\
-a + 3a; & 2 \leq x \leq 3, \\
0; & \text{elsewhere}.
\end{cases}$$

(i) Determine the constant $a$.

(ii) If $X_1, X_2$ and $X_3$ are three independent observations from $X$, what is the probability that exactly one of these three numbers is larger than 1.5?
1(a) Answer any TWO parts.
   i. Determine to which list the customers account number 2473871 should be attached if the company's computer is capable of searching a list of 100 items.
   ii. Let \((G, \ast)\) be a group defined on the set of real numbers by \(a \ast b = a + b + 2\), for all \(a, b \in G\). Determine the identity and inverse elements.
   iii. Find an integer \(n\) for which the rings \(Z_n\) need not have the following properties (a) \(a^2 = a\) implies \(a = 0\) or \(a = 1\), (b) \(ab = 0\) implies \(a = 0\) or \(b = 0\). Is the \(n\) you found prime?

1(b) Define an equivalence relation. For \(a, b \in \mathbb{Z}\), define \(aRb\) by \(a \equiv b \pmod{n}\) if and only if \(n\) divides \((a - b)\). Prove that \(R\) is an equivalence relation on \(\mathbb{Z}\).

2(a) i. Define the incidence matrix for a graph and show that the incidence matrix for a disconnected graph is a block diagonal matrix.
   ii. For a given a sequence of numbers 19, 25, 6, 9, 2, 11, 21, 47, 8, 39, 77, build a binary search tree.

2(b) Find the shortest path from the origin 'B' to the destination 'G' with the help of
Dijkstra's Algorithm for the following weighted graph. Show the intermediate computations.

2(b') Find the maximum flow in the given network by using Ford and Fulkerson Labeling Algorithm from the source 0 to the sink 5.

3(a) Solve any two recurrence relations:
   a) \( a_r - 4a_{r-1} + 4a_{r-2} = 2^r \)
   b) \( S(k) - 7S(k-1) + 105(k-2) = 6 + 8k \)
   c) \( a_n + 8a_{n-2} + 16a_{n-4} = 0 \)
3(b) Use generating function to solve the recurrence relation
\[ a_n - 9a_{n-1} - 26a_{n-2} - 24a_{n-3} = 0, \quad n \geq 3, \text{ with } a_0 = 0 \text{ and } a_1 = 1, \text{ and } a_2 = 10 \]  

4(a) Solve the following Linear Programming Problem by Simplex Method
\[ \text{Max } Z = -2x_1 - x_2 \]
Subject to constraints:
\[ 3x_1 + x_2 = 3, \]
\[ 4x_1 + 3x_2 \geq 6, \]
\[ x_1 + 2x_2 \leq 4, \text{ and } \]
\[ x_1, x_2 \geq 0. \]  

4(b) Using Graphical Method solve the following LPP:
\[ \text{Max } z = x_1 + x_2 \]
Subject to
\[ x_1 + x_2 \leq 1, \]
\[ -3x_1 + x_2 \geq 3; \]
\[ x_1, x_2 \geq 0. \]  

OR

4(b') Find the dual of the following LPP:
\[ \text{Max } z = 5x_1 + 6x_2 \]
Subject to
\[ x_1 + 2x_2 = 5, \]
\[ -x_1 + 5x_2 \geq 3; \]
\[ x_2 \geq 0 \text{ and } x_1 \text{ is unrestricted.} \]
2016-17
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
COMPUTER ARCHITECTURE
CO-208

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.  Question  M.M.

1(a) Design an arithmetic circuit with two selection variables $S_1$ and $S_0$ and two $n$-bit data inputs $A$ and $B$. The circuit generates eight arithmetic operations in conjunction with carry $C_{in}$ as shown in the table below. Draw the logic diagram for the two least significant bits of the arithmetic circuit.

<table>
<thead>
<tr>
<th>$S_1$</th>
<th>$S_0$</th>
<th>$C_{in} = 0$</th>
<th>$C_{in} = 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>$F = A$</td>
<td>$F = A + 1$</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>$F = A - B - 1$</td>
<td>$F = A - B$</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>$F = B - A - 1$</td>
<td>$F = B - A$</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>$F = A + B$</td>
<td>$F = A + B + 1$</td>
</tr>
</tbody>
</table>

1(b) Explain the single and double precision IEEE 754 standard Floating Point representation with suitable examples.

OR

1'(a) With the help of suitable diagrams show how a common bus system can be constructed using:
   i. Multiplexers
   ii. Tri-state Buffers

1'(b) What is a micro-operation? What are the different types of Micro-operations? Discuss in detail with suitable examples.

2(a) With the help of a suitable block diagram, explain the hardware organization of an associative memory. Derive the match logic for one word of associative memory.

contd...
2(b) A magnetic disk system has the following parameters:

$T_s =$ average time to position the magnetic head over a track.

$R =$ rotation speed of disk in revolutions per second.

$N_t =$ number of bits per track.

$N_s =$ number of bits per sector.

Calculate the average time $T_a$ that it will take to read one sector.

OR

2'(a) Discuss in detail the various addressing modes of an instruction. Use relevant examples.

2'(b) With the help of a flowchart, explain the interrupt cycle.

3(a) With the help of a suitable block diagram, explain the organization and working of a general purpose micro-programmed control unit.

3(b) A control unit has three inputs $x$, $y$, and $z$ and its state diagram is shown below:

![State Diagram]

Design the control unit using counter, decoder and a PLA.

4(a) Discuss the Flynn’s Classification of computers.

4(b) A non-pipeline system takes 500 ns to process a task. The same task can be processed in a six segment pipeline. The time delay of the six segments in the pipeline are $t_1 = 50$ ns, $t_2 = 30$ ns, $t_3 = 95$ ns, $t_4 = 45$ ns, $t_5 = 25$ ns and $t_6 = 55$ ns. The interface registers’ delay time $t_r = 5$ ns. Determine the following:

i. Speedup ratio of the pipeline for 100 tasks.

ii. Maximum Speedup that can be achieved for this pipeline.

iii. Efficiency of the pipeline.

************
2016-17
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
SOFTWARE ENGINEERING
CO-209

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. Question M.M.
1(a) How is cost of the prototype kept low? Give at least three distinct suggestions which are substantial in nature. [7.5]
1(b) Give brief explanation of followings – [7.5]
i) Why should errors in software development be fixed early?
ii) Why failure rate in software may increase after fixing a defect?
2(a) Suggest metrics for followings – [7.5]
i) To determine if requirements are stable.
ii) To determine if requirements are ambiguous.
2(b) What is milestone analysis? Prepare Cost-schedule-milestone graph on the basis of following data – [7.5]

<table>
<thead>
<tr>
<th>Milestone</th>
<th>As Per Plan</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Date of Completion</td>
<td>Cost Incurred</td>
</tr>
<tr>
<td>Product Design</td>
<td>15 Feb’16</td>
<td>12</td>
</tr>
<tr>
<td>Detailed Design</td>
<td>20 Apr’16</td>
<td>20</td>
</tr>
<tr>
<td>Code &amp; Unit Test</td>
<td>20 July’16</td>
<td>25</td>
</tr>
<tr>
<td>Integration Test</td>
<td>15 Oct’16</td>
<td>50</td>
</tr>
</tbody>
</table>

OR

2'(a) List characteristics of egoless team organization. [7.5]
2'(b) Estimate effort using COCOMO model for an organic type project whose size has been estimated at 20 KLOC. Assume nominal values for cost drivers. Determine phase-wise distribution of effort. Also estimate the duration of project. Use following data to calculate phase-wise distribution of effort –

<table>
<thead>
<tr>
<th>Size</th>
<th>% of effort across different phases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Product Design</td>
</tr>
<tr>
<td>8 KLOC</td>
<td>16%</td>
</tr>
<tr>
<td>32 KLOC</td>
<td>16%</td>
</tr>
</tbody>
</table>

3(a) Describe Pipe-and-Filter architectural style.  

3(b) What is temporal cohesion? Give an example of C function which contains temporal cohesion.  

OR

3'(a) Using diagram, show following types of modules in structure chart –
   i) Input Module  
   ii) Output Module  
   iii) Coordinate Module  
   iv) Transform Module  
   v) Compute Module  

3'(b) What is the significance of high fan-out of a module? How can fan-out of a module be reduced if it is high?  

4(a) Consider the software which converts temperature in Centigrade to Fahrenheit. Generate test cases by using equivalence class partitioning and boundary value analysis.  

4(b) With respect to configuration management, explain the followings –

i) Configuration Item  
ii) Version Management Procedure  
iii) Change Control Procedure
2016-17
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
SIGNALS AND SYSTEMS
EL-241

Maximum Marks: 60 Credits: 04 Duration: Two Hours

Answer all the questions.
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Q.No. Question M.M.
--- --- ---
1(a) Determine whether or not each of the following signals is periodic. If a signal is periodic, specify its fundamental period. (CO1)
   i) \( x(t) = 2 \sin(3t)^2 - 2 \cos(5t)^2 \)
   ii) \( y[n] = 5j e^{j\frac{3\pi}{7}(n+\frac{1}{2})} \)

OR

1(a') Determine whether the following systems are linear, time invariant and causal (CO1)
   i) \( y(t) = x(\sin(2t)) \)
   ii) \( y(t) = (t+1)^2 x(t-1) \)

1(b) Let \( h(t) = u(t-3) \) be the impulse response of an LTI system. Find the output, \( y(t) \), of the system for input \( x(t) = e^{3t}u(-t) \). (CO1)

1(c) Find the Exponential Fourier series coefficients, \( a[k] \), of a signal, \( x[n] \), given as \( x[n] = 2 + 4 \sin \left( \frac{\pi}{5} n \right) - 3 \cos \left( \frac{\pi}{5} n \right) + 7 \cos^2 \left( \frac{\pi}{5} n + \frac{\pi}{2} \right) \). (CO2)

2(a) Find the Fourier transform of a signal \( x(t) = e^{-|t|} \cos(\pi t) \). (CO2)

2(b) Find the inverse Laplace transform of \( X(s) = \frac{3}{(s-4)(s+5)} \) if the region of convergence is
   i) \(-5 < Re\{s\} < 4\)
   ii) \( Re\{s\} > 4\)

Also, determine whether the system is stable or unstable in each case.

OR

contd...-2
2(b') Find the inverse z-transform of $X(z) = \frac{1}{(1-0.5z^{-1})(1-0.25z^{-1})}$ if the region of convergence is

i) $|z| > 0.5$

ii) $0.25 < |z| < 0.5$

Also, determine whether the system is stable or unstable in each case.

2(c) State the sampling theorem. Let $x(t)$ be a signal with Nyquist rate $w_0$. Determine the Nyquist rate of the following signals

i) $y(t) = x(t) + x(t - 1)$

ii) $g(t) = x(t) \cos(w_0t)$

3(a) Obtain the overall transfer function, $H(s)$, of the system shown in Fig. 1 using block reduction technique. Also, obtain the linear constant coefficient differential equation of the system.

3(a') A system is described by the circuit given in Fig. 2. Voltages $V_i(t)$ and $V_o(t)$ are considered as input and output of this system, respectively. Find the

i) Transfer function of the system.

ii) order of the system.

iii) type of filter (lowpass, highpass or bandpass).

iv) cut-off frequency of the filter.

**Fig. 1**

**OR**

**Fig. 2**

Contd... 3.
3(b) Construct the signal flow graph and obtain the transfer function using Mason’s Gain formula for a system defined by the following set of equations (CO4)

\[
\begin{align*}
x_2 &= G_1 x_1 - H_2 x_6 ; \\
x_3 &= G_2 x_2 ; \\
x_4 &= G_3 x_3 + G_6 x_2 - H_1 x_5 ; \\
x_5 &= G_4 x_4 ; \\
x_6 &= G_5 x_5 + G_7 x_3
\end{align*}
\]

where \( x_1, x_2, x_3, x_4, x_5, x_6 \) and \( G_1, G_2, G_3, G_4, G_5, G_7, H_1, H_2 \) are nodes and transmittances, respectively.

4(a) The probability distribution function of a continuous random variable, \( X \), is defined as (CO5)

\[
F_X(x) = \begin{cases} 
0, & x \leq -5 \\
\frac{1}{100} (x + 5)^2, & -5 < x \leq 5 \\
1, & x > 5
\end{cases}
\]

Find
i) \( P(X \leq -1) \)
ii) \( P(X > 1) \)
iii) \( P(-4 < X \leq -2) \)
iv) \( P(X > 5) \)

Also, obtain the probability density function of \( X \).

4(b) The probability density function of a random variable \( X \) is given by (CO5)

\[
p_X(x) = \begin{cases} 
\frac{1}{10}, & -5 < x \leq 5 \\
0, & \text{elsewhere}
\end{cases}
\]

Find the probability density function, \( p_Y(y) \), of random variable \( Y \) defined as

\[Y = 2X + 10\]

4(c) Attempt any two of the following (CO5)

i) Define auto-correlation function
ii) Define power spectral density (PSD) for wide sense stationary (WSS) random process.
iii) Define cross-correlation function.