1. (8 points) A new Company has established a contributory pension plan on January 1, 2001. You are given:

**Plan Provisions**

- **Retirement benefit:** The greater of:
  1. 2% of career average earnings, or
  2. Actuarial equivalent of 200% of employee contributions accumulated at the fund rate of return

- **Normal form of payment:** 5 years certain and life thereafter, payable monthly in advance

- **Normal retirement age:** 65

- **Employee contributions:** 4% of annual earnings, payable at the beginning of the year

- **Termination or death benefit:** Lump sum payment of 200% of employee contributions accumulated at the fund rate of return

- **Actuarial equivalence:** At valuation assumptions

**Actuarial Assumptions and Methods**

- **Interest rate:** 6.5% per annum
- **Retirement age:** 65
- **Salary increases:** 4.0% per annum

**Termination rates:**

<table>
<thead>
<tr>
<th>Attained Age</th>
<th>Year-end rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 34</td>
<td>10%</td>
</tr>
<tr>
<td>35 and over</td>
<td>0%</td>
</tr>
</tbody>
</table>

- **Other pre-retirement decrements:** None

- **Actuarial cost method:** Unit Credit
- **Actuarial value of assets:** Market value

\[
\bar{a}_{65}^{(12)} = 10.4
\]
1. (CONTINUED)

### Participant Data

<table>
<thead>
<tr>
<th></th>
<th>Group J</th>
<th>Group K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of employees</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Age at 1/1/2001</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>2001 earnings per employee</td>
<td>$40,000</td>
<td>$60,000</td>
</tr>
</tbody>
</table>

(a) Calculate the employer normal cost for 2001.


Determine the plan’s assets and accrued liability at January 1, 2002.

(c) Calculate the gains and losses by source for 2001.

Show all work.
2. (4 points) The CEO of ABC Company will receive a pension on retirement at age 65.

You are given the following as at January 1, 2001:

- CEO’s Age: 50
- CEO’s Service: 10 years
- CEO’s Salary: $300,000 per annum
- Pension Benefit: 2% of final year’s salary times years of service
- Form of Payment: Life only, payable monthly in advance

The pension is paid from a basic plan and a supplemental executive plan. The maximum annual pension payable under the Basic Plan is $2,000 times years of service. The remainder is paid from the Supplemental Plan. ABC pre-funds the CEO’s entire pension.

**Actuarial Assumptions and Method**

<table>
<thead>
<tr>
<th></th>
<th>Basic Plan</th>
<th>Supplemental Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest rate:</td>
<td>8% per annum</td>
<td>6% per annum</td>
</tr>
<tr>
<td>Salary scale:</td>
<td>5% per annum</td>
<td>5% per annum</td>
</tr>
<tr>
<td>Normal retirement age:</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Pre-retirement decrements:</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Actuarial Cost Method:</td>
<td>Projected Unit Credit (prorated on service)</td>
<td>Entry Age Normal (level % of pay)</td>
</tr>
<tr>
<td>$a_{65}^{12}$</td>
<td>9.0</td>
<td>11.0</td>
</tr>
</tbody>
</table>

(a) Calculate the normal cost for the Basic Plan at January 1, 2001.

(b) Calculate the normal cost for the Supplemental Plan at January 1, 2001.

Show all work.
3. (8 points) You are the actuary for a company that sponsors a non-contributory defined benefit pension plan.

You are given:

**Plan Provisions**

- Retirement benefit: $20 per month, per year of service
- Normal form of pension: Life only, payable monthly in advance
- Normal retirement age: 60
- Early retirement reduction: 5% per year that retirement precedes age 60
- Other ancillary benefits: None

**Actuarial Assumptions and Method**

- Interest rate: 7.0% per annum
- Retirement rates: 10% per annum, at the beginning of each year, from age 57 through 59; 100% at age 60
- Pre-retirement decrements: None
- Actuarial cost method: Unit Credit

\[
\begin{align*}
\bar{a}_{57}^{(12)} &= 10.0 \\
\bar{a}_{58}^{(12)} &= 9.0 \\
\bar{a}_{59}^{(12)} &= 8.0 \\
\bar{a}_{60}^{(12)} &= 7.0
\end{align*}
\]

**Financial Information**

- Assets at January 1, 2001: $100,000
- 2001 employer contribution: None
- Fund rate of return in 2001: 2%

**Participant Data as at January 1, 2001**

<table>
<thead>
<tr>
<th>Member</th>
<th>Age</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jean</td>
<td>57</td>
<td>25</td>
</tr>
<tr>
<td>Kelly</td>
<td>58</td>
<td>29</td>
</tr>
</tbody>
</table>
3.  (CONTINUED)

(a) Calculate the unfunded accrued liability and normal cost as at January 1, 2001.

(b) On December 31, 2001, Kelly retires. On December 31, 2001, Pat transfers into the plan at age 45 and $10,000 is transferred to recognize 10 years of Pat’s prior service.

Calculate the unfunded accrued liability as at January 1, 2002.

(c) Calculate the gains and losses by source for 2001.

Show all work.
You are given:

**Plan Provisions**

- **Retirement benefit:** $30 per month, per year of service
- **Normal form of payment:** Five years certain and life thereafter, payable monthly in advance
- **Optional form of payment:** Actuarially equivalent 75% joint and survivor annuity
- **Normal retirement age:** 65
- **Early retirement reduction:** Actuarial equivalence
- **Other ancillary benefits:** None
- **Actuarial equivalence:** Based on valuation assumptions

**Actuarial Assumptions and Method**

- **Interest rate:** 7.0% per annum
- **Retirement age:** 65
- **Pre-retirement decrements:** None
- **Actuarial cost method:** Entry Age Normal

<table>
<thead>
<tr>
<th>Member</th>
<th>Spouse</th>
<th>Member: Spouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a_{60}^{(12)} = 10.8387$</td>
<td>$a_{57}^{(12)} = 12.5296$</td>
<td>$a_{60:57}^{(12)} = 9.7460$</td>
</tr>
<tr>
<td>$a_{65}^{(12)} = 9.7004$</td>
<td>$a_{62}^{(12)} = 11.6834$</td>
<td>$a_{65:62}^{(12)} = 8.5126$</td>
</tr>
<tr>
<td>$a_{70}^{(12)} = 8.4642$</td>
<td>$a_{67}^{(12)} = 10.6379$</td>
<td>$a_{70:67}^{(12)} = 7.1863$</td>
</tr>
<tr>
<td>$sP_{60} = 0.9446$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$sP_{65} = 0.9039$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following member retires on January 1, 2001:

**Data as at January 1, 2001**

- **Member’s age:** 60
- **Spouse’s age:** 57
- **Years of service:** 35
4. (CONTINUED)

(a) Calculate the experience gain or loss on January 1, 2001 caused by the retirement of the member.

(b) Calculate the member’s pension under the optional form of payment.

Show all work.
5. (6 points) Your client sponsors a non-contributory defined benefit pension plan.

You are given:

**Plan Provisions**
- Retirement benefit: 1.5% of career average earnings
- Normal form of payment: Life only, payable monthly in advance
- Normal retirement age: 65
- Earliest retirement age: 55
- Early retirement reduction: 3% per year that retirement precedes age 65

**Actuarial Assumptions**
- Interest rate: 6.5% per annum
- Salary increase rate: 4.0% per annum
- Retirement age: 60
- Pre-retirement decrements: None
- Actuarial value of assets: Market value

\[ a_{60}^{(12)} = 11.4 \]

Assets at January 1, 2001 equal the January 1, 2001 Unit Credit accrued liability.

**Participant data as at January 1, 2001**

<table>
<thead>
<tr>
<th>Members</th>
<th>Age</th>
<th>Service (Years)</th>
<th>2001 Earnings</th>
<th>Accrued Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>41</td>
<td>11</td>
<td>$50,000</td>
<td>$6,000</td>
</tr>
<tr>
<td>K</td>
<td>53</td>
<td>18</td>
<td>60,000</td>
<td>12,000</td>
</tr>
</tbody>
</table>

(a) Determine the normal cost under the Frozen Initial Liability method given that this method was adopted on January 1, 2001.

(b) Determine the normal cost under the Individual Aggregate cost method, assuming that assets allocated to each member equal their respective Unit Credit accrued liability.

Show all work.

**END OF EXAMINATION**