1. (9 points) NOC and its union have negotiated the following changes to NOC’s Full-Time Hourly Union Pension Plan:

<table>
<thead>
<tr>
<th>Benefit Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesting</td>
<td>100% immediate vesting</td>
</tr>
<tr>
<td>Early Retirement Age</td>
<td>50 with 10 years of service</td>
</tr>
<tr>
<td>Normal Retirement Benefit</td>
<td>$80 per month times years of service for terminations/retirements during 2003 and beyond.</td>
</tr>
<tr>
<td>Early Retirement Benefit</td>
<td>Unreduced benefit at age 62 with 30 years of service, otherwise reduced by 0.4% per month that early retirement precedes Normal Retirement Age.</td>
</tr>
<tr>
<td>Disability Benefit</td>
<td>Continued benefit accrual until participant commences disability retirement benefit. Disabled participants can receive their unreduced accrued Normal Retirement Benefit at any age.</td>
</tr>
</tbody>
</table>

(a) Describe issues associated with the design and introduction of this disability benefit.

(b) Describe the effect of these plan changes on the funding and expense actuarial valuations and their results.
2. (8 points) NOC is acquiring SmallSub, a subsidiary of LargeCo. NOC is purchasing the assets of SmallSub. Employees of SmallSub will be offered employment with NOC after the sale.

The employees of SmallSub participate in a DB ERP, sponsored by LargeCo, with a benefit of 3% of best average earnings times years of service with SmallSub. All other provisions mirror NOC’s Full-Time Salaried Pension Plan.

There are two options being proposed for pension benefits for employees transferring from SmallSub.

Option 1

All SmallSub employees hired by NOC join NOC’s Full-Time Salaried Pension Plan. Their past service benefits remain with the SmallSub pension plan.

Option 2

NOC would become the plan sponsor of the existing SmallSub pension plan. The benefit formula would be amended to the greater of:

- the frozen accrued benefit on the date of sale, or

- 2% of best average earnings times years of service with SmallSub and NOC.

(a) Evaluate Option 1 and Option 2 from the perspective of NOC.

(b) Evaluate Option 1 and Option 2 from the perspective of the transferring SmallSub employees.
3. (7 points) NOC is considering improving the early retirement benefit for the Full-Time Salaried Pension Plan.

The early retirement benefit after January 1, 2003 would be the greater of:

(i) Accrued Benefit reduced by 0.25% per month that early retirement precedes age 62, or

(ii) Accrued Benefit reduced by 0.25% per month that early retirement precedes 90 points (age plus service).

The following is a projected age/service table as at January 1, 2003 for the Full-Time Salaried Pension Plan provided to you by NOC.

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>&lt; 5</th>
<th>5-10</th>
<th>10-15</th>
<th>15-20</th>
<th>&gt; 20</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25 # Participants</td>
<td>185</td>
<td>70</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>255</td>
</tr>
<tr>
<td>Average Salary</td>
<td>29,800</td>
<td>43,000</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>33,424</td>
</tr>
<tr>
<td>25-35 # Participants</td>
<td>217</td>
<td>165</td>
<td>80</td>
<td>9</td>
<td>3</td>
<td>474</td>
</tr>
<tr>
<td>Average Salary</td>
<td>43,400</td>
<td>53,700</td>
<td>59,000</td>
<td>61,600</td>
<td>55,000</td>
<td>50,037</td>
</tr>
<tr>
<td>35-45 # Participants</td>
<td>250</td>
<td>229</td>
<td>523</td>
<td>375</td>
<td>115</td>
<td>1,490</td>
</tr>
<tr>
<td>Average Salary</td>
<td>55,000</td>
<td>62,000</td>
<td>64,500</td>
<td>71,300</td>
<td>72,000</td>
<td>69,396</td>
</tr>
<tr>
<td>45-55 # Participants</td>
<td>175</td>
<td>140</td>
<td>125</td>
<td>400</td>
<td>650</td>
<td>1,490</td>
</tr>
<tr>
<td>Average Salary</td>
<td>58,700</td>
<td>62,000</td>
<td>65,900</td>
<td>71,900</td>
<td>73,000</td>
<td>69,396</td>
</tr>
<tr>
<td>55-65 # Participants</td>
<td>75</td>
<td>99</td>
<td>74</td>
<td>90</td>
<td>347</td>
<td>685</td>
</tr>
<tr>
<td>Average Salary</td>
<td>54,800</td>
<td>63,100</td>
<td>63,400</td>
<td>69,700</td>
<td>70,200</td>
<td>66,687</td>
</tr>
<tr>
<td>&gt; 65 # Participants</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>7</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Average Salary</td>
<td>45,100</td>
<td>48,100</td>
<td>44,200</td>
<td>54,000</td>
<td>49,800</td>
<td>48,411</td>
</tr>
<tr>
<td>Totals # Participants</td>
<td>906</td>
<td>709</td>
<td>811</td>
<td>881</td>
<td>1,125</td>
<td>4,432</td>
</tr>
<tr>
<td>Average Salary</td>
<td>47,730</td>
<td>58,228</td>
<td>63,848</td>
<td>71,172</td>
<td>71,780</td>
<td>63,124</td>
</tr>
<tr>
<td>Average Age</td>
<td>44.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Service</td>
<td>14.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Salary</td>
<td>63,124</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. (CONTINUED)

(a) Assess the reasonableness of using this age/service table.

(b) Using the table from NOC, evaluate the effect of the proposed improvement on the plan’s funding results.
4. (10 points) Belair is introducing a public employees’ pension plan to cover its firefighters and teachers.

(a) Describe the factors that should be considered in establishing the funding policy for a public employees’ pension plan.

(b) Describe the significant differences in the selection and review of actuarial assumptions for the valuation of public employees’ versus private pension plans.

(c) Recommend design features for the plan to attract and meet the needs of

(i) firefighters, and

(ii) teachers.

(d) Belair’s population is aging dramatically. Describe the particular design features to be considered for the public employees’ pension plan.
5. (12 points) Retiree medical premiums are expected to increase by 25% this year. The CEO of NOC is proposing to drop retiree medical coverage and increase pension benefits to replace the lost medical benefits.

(a) Describe the effect of the CEO’s proposal on pension expense and funding.

(b) Describe alternative retirement plan design options that could meet the CEO’s objective.

(c) Calculate the 2002 expense for the retiree medical plan if coverage is eliminated for some of the active participants causing the active APBO and service cost to decrease by 60%.

Show all work.

(d) Evaluate other cost containment alternatives for NOC’s retiree medical plan.
6. (14 points) NOC has declared bankruptcy. As a result, the government of Belair has imposed the termination of each of NOC’s Eligible Retirement Plans (ERPs) effective January 1, 2002.

You are given the following information as at January 1, 2002:

<table>
<thead>
<tr>
<th></th>
<th>NOC Full-Time Salaried Pension Plan</th>
<th>NOC Full-Time Hourly Union Pension Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total plan termination liabilities (000’s)</td>
<td>$450,000</td>
<td>$480,000</td>
</tr>
<tr>
<td>Active members</td>
<td>$380,000</td>
<td>$375,000</td>
</tr>
<tr>
<td>Inactive members</td>
<td>$70,000</td>
<td>$105,000</td>
</tr>
</tbody>
</table>

Liability duration (years)
- Active members: 12, 15
- Inactive members: 5, 8

You are given:
- Plan termination liabilities have been determined based on benefits accrued to January 1, 2002.
- Plan termination liabilities have been valued using the annuity purchase rate at January 1, 2002 of 6.25% per annum.
- Active members’ termination entitlements will be paid on December 31, 2002. The amount paid will be the plan termination liability as at January 1, 2002 updated with interest at 6.25% per annum to the date of payment.
- Inactive members will receive an annuity purchased on December 31, 2002 from an insurance company on their behalf.
6.  (CONTINUED)

(a)  *(4 points)* Assess the effect that the bankruptcy of NOC will have on the benefits provided to members of each of NOC’s retirement plans.

(b)  *(3 points)* Formulate an investment strategy for the NOC Full-Time Salaried Pension Plan and the NOC Full-Time Hourly Union Pension Plan for 2002. Contrast this to the current investment strategy.

(c)  *(7 points)* Assuming that annuity purchase rates drop to 5.75% at December 31, 2002 and assets return 9% during 2002, calculate the 2002 expense and accounting disclosure for each of NOC’s terminated ERPs.

Show all work.

**END OF EXAMINATION**

MORNING SESSION
7. (12 points) Belair has just adopted a new Social Security Retirement System. Companies are allowed a one-time election to participate in the system or opt out. Companies that opt out are required to provide a mandatory minimum retirement benefit.

Social Security Retirement System Provisions

- Retirement benefits are payable at age 65.

- The retirement benefit is 0.5% of a worker’s best 5-year average covered earnings times years of covered service, indexed for post retirement cost of living increases.

- Covered earnings are limited to $50,000 per year, indexed for cost of living increases.

- A year of covered service is credited for each year in which a contribution is paid, to a maximum of 40 years.

- Covered Service commences on January 1, 2002.

- The system is funded by employer contributions of 4% of covered earnings matched by equal employee contributions.

- The contributions are tax deductible to the employer and the employee.

Minimum opt out benefit

(i) a DC ERP with employer contributions equal to 6% of earnings up to the covered earnings limit, or

(ii) a DB ERP paying at least 0.8% of best 5-year average earnings up to the covered earning limit times years of service after January 1, 2002, payable at age 65.
7. (CONTINUED)  

(a) Explain the issues NOC needs to consider in deciding whether to opt in or out of the Social Security Retirement System.

(b) Evaluate NOC’s ERPs with respect to opting in or out of the Social Security Retirement System and make a recommendation. Justify your response.
8. (11 points) NOC is converting its SRP to a DC ERP for future service effective December 31, 2001. SRP benefits are determined at the executive’s retirement date, using earnings at that time, but service accrued to December 31, 2001.

(a) What factors should NOC consider in determining an appropriate DC contribution formula?

(b) Evaluate this change from both the executives’ and NOC’s point of view.

(c) Analyze the effect of this change on 2001 and 2002 expense.

(d) NOC executives are offered the opportunity on January 1, 2002 to take their accrued SRP benefit as a lump sum cash payment. Calculate the effect on the 2002 expense given the following:

<table>
<thead>
<tr>
<th>Accepted</th>
<th>Declined</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>Average age</td>
<td>48.9</td>
<td>53.1</td>
</tr>
<tr>
<td>Average future working lifetime (years)</td>
<td>8.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Average earnings (2001)</td>
<td>$260,000</td>
<td>$330,000</td>
</tr>
<tr>
<td>Projected benefits obligation prior to distribution</td>
<td>$6,597,000</td>
<td>$12,187,000</td>
</tr>
<tr>
<td>Lump sum distributions</td>
<td>$5,867,000</td>
<td>$0</td>
</tr>
</tbody>
</table>
9. *(7 points)* You are employed by Big Bank and are the actuary for NOC. The investment arm of Big Bank sends a proposal to NOC’s CEO offering a bundled package of services if the pension assets are moved to Big Bank. The bundled services include better financing terms for NOC and a reduction in actuarial service fees.

(a) Calculate the 2001 risk adjusted rate of return for each of NOC’s retirement funds, given:

\[ \beta = 0.9 \]
\[ R_f = 0.04 \]
\[ R_m = 0.03 \]

Show all work.

(b) Describe how a Statement of Investment Policy can help the CEO evaluate investment manager performance.

(c) Describe the CEO’s obligations to the plans and to NOC.

(d) Describe your professional obligations to the plans and to NOC.
1. (5 points) You are the actuary for a company that sponsors a non-contributory, final pay, defined benefit pension plan. You are given:

**Actuarial Assumptions and Methods**

- Interest rate: 6.0% per annum
- Salary increases: 4.0% per annum
- Retirement age: 65
- Pre-retirement decrements: None
- Actuarial cost method: Aggregate
- Actuarial value of assets: Market value

**Financial Information as at January 1, 2002**

- Market value of assets: $13,500

**Participants as at January 1, 2002**

<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
<th>Age</th>
<th>Present Value of Future Benefits (PVFB)</th>
<th>2002 Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pat</td>
<td>Active</td>
<td>60</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Chris</td>
<td>Active</td>
<td>40</td>
<td>$10,000</td>
<td>$30,000</td>
</tr>
<tr>
<td>Kelly</td>
<td>Retired</td>
<td>65</td>
<td>$7,500</td>
<td>N/A</td>
</tr>
</tbody>
</table>

(a) Calculate the normal cost as at January 1, 2002.

(b) Calculate the January 1, 2002 normal cost under the Individual Aggregate method assuming that assets for active participants are allocated in proportion to their PVFB.

(c) Evaluate the appropriateness of Aggregate vs. Individual Aggregate if the plan is expected to be terminated in five years when Pat retires.

Show all work.
2. (7 points) Your client maintains a non-contributory defined benefit pension plan with one member. You are given:

**Plan Provisions**

Normal retirement benefit: 1.0% of final year’s earnings times credited service
Normal form of pension: 5-year certain, life thereafter
Normal retirement age: Age 65
Early retirement eligibility: Age 55
Early retirement bridge benefit: Temporary benefit equal to 0.5% of final year’s earnings times credited service, payable until the earlier of death and age 65
Early retirement reduction: 5% per year that retirement precedes age 65, applied to both the normal and bridge benefits

Other ancillary benefits: None

**Actuarial Assumptions and Method**

Interest rate: 6.0% per annum
Salary increases: 3.0% per annum
Retirement rates: 50% at age 62 and 100% at age 65
Actuarial cost method: Entry Age Normal (level percent of earnings)

Pre-retirement commutation factors:

<table>
<thead>
<tr>
<th>Age</th>
<th>$D_x$</th>
<th>$N_x$</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>396</td>
<td>8084</td>
</tr>
<tr>
<td>47</td>
<td>250</td>
<td>3234</td>
</tr>
<tr>
<td>62</td>
<td>119</td>
<td>287</td>
</tr>
<tr>
<td>65</td>
<td>54</td>
<td>54</td>
</tr>
</tbody>
</table>

Annuity factors and survival probability factors:

\[ a_{62}^{(12)} = 10.7 \]
\[ a_{65}^{(12)} = 9.9 \]
\[ a_{67}^{(12)} = 9.4 \]
\[ a_{70}^{(12)} = 8.5 \]
\[ s_{62} = 0.96 \]
\[ s_{65} = 0.93 \]
\[ s_{65} = 0.90 \]
2. Continued

Participant Data as at January 1, 2002

Age: 47
Credited service: 15 years
2001 Earnings: $60,000

Calculate the accrued liability and normal cost at January 1, 2002.

Show all work.
3. (4 points) Your client maintains a non-contributory defined benefit pension plan.

You are given:

**Plan Provisions**

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal retirement benefit:</td>
<td>$20 per month per year of service</td>
<td>1% of final earnings times years of service</td>
</tr>
<tr>
<td>Normal form of payment:</td>
<td>Life only</td>
<td>Married: Joint and 75% survivor, without reduction Unmarried: Life only</td>
</tr>
<tr>
<td>Normal retirement age:</td>
<td>65</td>
<td>60</td>
</tr>
<tr>
<td>Ancillary benefits:</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

**Actuarial Assumptions and Method**

- Interest rate: 6.5% per annum
- Salary increases: 4.5% per annum
- Pre-retirement decrements: None
- Retirement age: Normal retirement age
- Post-retirement mortality: Unisex
- Probability of being married at retirement: 85%
- Spouse age: 5 years younger than participant
- Actuarial cost method: Projected Unit Credit (pro-rated on service)

**Annuity factors**

\[
\begin{align*}
\bar{a}_{55}^{(12)} &= 11.8 \\
\bar{a}_{60}^{(12)} &= 10.8 \\
\bar{a}_{65}^{(12)} &= 9.6 \\
\bar{a}_{60,55}^{(12)} &= 9.7 
\end{align*}
\]
3. Continued

Participant Data as at January 1, 2002

Age: 47
Service: 10 years
2001 Earnings: $36,000

Calculate the increase in the accrued liability and normal cost as at January 1, 2002 if the proposed provisions are adopted.

Show all work.
4. (7 points) You are the actuary for a company with a non-contributory defined benefit pension plan established on January 1, 2002. You are given:

**Plan Provisions**

Retirement benefit: 1% of final salary times years of service
Normal form of payment: Life only, payable monthly in advance
Normal retirement age: 60
Ancillary benefits: None

**Actuarial Assumptions**

Interest rate: 6.5% per annum
Salary increases: 4.0% per annum
Retirement age: 60
Pre-retirement decrements: None

\[
\bar{a}_{60}^{(12)} = 114
\]

**Financial Information**

There are no assets in the plan at January 1, 2002.

**Participant Data as at January 1, 2002**

<table>
<thead>
<tr>
<th>Employee</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>35</td>
<td>55</td>
</tr>
<tr>
<td>Service (years)</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>2001 Salary</td>
<td>$30,000</td>
<td>$50,000</td>
</tr>
</tbody>
</table>

The company will contribute, at the beginning of each year, an amount equal to the normal cost plus a payment to amortize any unfunded accrued liability over 15 years.

(a) Determine the company contribution at January 1, 2002 using each of the following methods:

(i) Individual Level Premium, and

(ii) Modified Aggregate.

(b) Assuming that the fund earns 0% and that salaries increase by 10% during 2002, calculate the accrued liability and company contribution at January 1, 2003 under the above methods.

Show all work.
5. *(7 points)* You are the actuary for a company that sets up a new non-contributory defined benefit pension plan on January 1, 2002. You are given:

**Plan Provisions**

Retirement benefit: $50 per month times years of service
Normal form of payment: Life only, payable monthly in advance
Normal retirement age: 65
Earliest retirement age: 55
Early retirement benefit: Accrued pension, reduced 4% per year that retirement precedes age 65
Other ancillary benefits: None

**Actuarial Assumption and Methods**

Interest rate: 6.5% per annum
Retirement age: 62
Pre-retirement decrements: None
Actuarial cost method: Attained Age Normal
Actuarial value of assets: Market value

\[
\bar{a}_{35}^{(12)} = 12.0 \\
\bar{a}_{62}^{(12)} = 11.0
\]

**Financial Information**

Assets at January 1, 2002: $0
Assets at January 1, 2003: $17,500
The company contributed $15,000 on January 1, 2002.

**Participant data as at January 1, 2002**

<table>
<thead>
<tr>
<th>Member</th>
<th>Age</th>
<th>Service (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>54</td>
<td>20</td>
</tr>
<tr>
<td>Y</td>
<td>30</td>
<td>4</td>
</tr>
</tbody>
</table>
5. Continued

(a) Determine the accrued liability and normal cost as at January 1, 2002.

(b) On December 31, 2002, Member X retires. Calculate the accrued liability and normal cost as at January 1, 2003.

(c) Reconcile the change in the normal cost by source.

Show all work.

**END OF EXAMINATION**