Dept of Mathematics and Statistics
King Fahd University of Petroleum & Minerals

AS482: Actuarial Contingencies II
Dr. Mohammad H. Omar
Major 3 Exam Term 132 FORM A
Thursday May 1 2014
10.00am-11.30am

Name_____ ID#:_ _ _ _ _ _ _ _ _ Serial #:_ _ _

Instructions.

1. Please turn off your cell phones and place them under your chair. Any student caught with mobile phones on during the exam will be considered under the **cheating rules** of the University.
2. If you need to leave the room, please do so quietly so not to disturb others taking the test. No two person can leave the room at the same time. No extra time will be provided for the time missed outside the classroom.
3. Only materials provided by the instructor can be present on the table during the exam.
4. Do not spend too much time on any one question. If a question seems too difficult, leave it and go on.
5. Use the blank portions of each page for your work. Extra blank pages can be provided if necessary. If you use an extra page, indicate clearly what problem you are working on.
6. Only answers supported by work will be considered. Unsupported guesses will not be graded.
7. While every attempt is made to avoid defective questions, sometimes they do occur. In the rare event that you believe a question is defective, the instructor cannot give you any guidance beyond these instructions.
8. Mobile calculators, I-pad, or communicable devices are disallowed. Use regular scientific calculators or financail calculators only. Write important steps to arrive at the solution of the following problems.

The test is 90 minutes, GOOD LUCK, and you may begin now!

Question	Total Marks	Marks Obtained	Comments
1	4		
2	3+2+3+4=11		
3	9		
4	5		
5	3+3=6		
6	1+4=5		
Total	40		

Extra blank page

1. (4 points) A 20-year endowment contract of face amount 100 000 is issued to (40) and surrendered at age 55. The cash value at that time is 60 000. If the extended term insurance option is selected, find the amount of **pure endowment payable at age 60** using the attached life table with 6% interest.

2. (3+2+3+4=11 points) Consider a newly hired employee age 30, earning 100000 in the first year of employment. Regular salary increases are assumed to be 4% per year; in addition, employees are assumed to receive merit increases of 6% each of their first three employment anniversaries. The pension benefit formula is 1% of the final five year average salary per year of service.

(a) Find the **five-year average** salary.
(b) Find the **projected pension benefit** at age 65
(c) Find the employee's **replacement ratio**, defined as the pension benefit divided by the final year's salary.
(d) What would a 1% **career average** benefit be as a percentage of this final five year average benefit?

3. (6+3=9 points) An annuity company sells the following two products:

(a) A five year annual payment temporary **immediate annuity**
(b) A five year **pure endowment**

The national regulatory authority requires the following two-step interest rate test in order to determine if the annuity company must hold additional capital:

(1) The *net single premium* (NSP) for each product is calculated under three deterministic interest rate scenarios:
   (i) Rates remain level at the *current* rate.
   (ii) Rates *rise additively* by 1% per year until they reach twice the current rate, and then remain level in succeeding years.
   (iii) Rates *fall additively* by 1% per year until they reach one-half the current rate, and then remain level in succeeding years.

(2) If the NSP under the falling interest rate scenario is 5% or more above the NSP in the level rate case, the company must hold additional capital.

If the probability of death in any given year remain constant at $q_x = 0.02$ and the current interest rate is 6%, determine whether this annuity company must hold additional capital for either product.

4. (5 points) A five year pure endowment contract issued to a person age 40 is funded with level annual premiums and has a maturity benefit of \$5 000. Premiums are payable at the beginning of each year, and the benefit is payable at the end of the fifth year. The table below shows mortality rates for a 40-year old and forward rates that are currently available. Use this information to calculate the net level annual premium for the pure endowment. Note that $f_{0,5} = z_5$.

y	$f_{y,5-y}$	x	q_x
0	4.0%	40	0.02
1	5.0	41	0.03
2	6.0	42	0.04
3	7.0	43	0.05
4	8.0	44	0.06

5. (3+3=6 points) An equity-indexed UL contract of face amount 100 000 uses the annual *point-to-point indexing* method, with a 10% index cap, a 1% index floor, a 100% participation rate, a 4% premium expense rate, and an annual administration charge of 50. A premium of 1000 is paid at the **beginning** of each year, policy charges are deducted at the **beginning** of each year, and interest is credited at the **end** of each year. The following values apply over the **next three** years :

Year	**Index Closing Value**	**Cost of Insurance per 1000 of Amount at Risk**	**Surrender Charge per 1000 of Face Amount**
0	1000		
1	1080	2.0	5.00
2	1200	3.0	4.00
3	1100	4.0	3.00

(a) Find the **credited interest rate** for the contract at the **end** of each of the next three years.
(b) Find the **cash value of the contract** at the end of each of the next three years.

6. (1+4=5 points) For a fully discrete 3-year term life insurance policy on (60) you are given:

(i) The death benefit is 100,000.
(ii) Mortality follows the Illustrative Life Table as follows:

Age, x	l_x	d_x	$1000q_x$
60	81880.73	1126.7146	13.7604
61	80754.01	1212.2343	15.0114
62	79541.78	1302.9994	16.3813
63	78238.78	1399.0010	17.8812

(iii) The rate of interest is based on the yield curve at $t = 0$.
You are also given the following information about zero coupon bonds based on the yield curve at $t = 0$:

Years to Maturity	Price of 100 Bond
1	97.00
2	92.00
3	87.00

Calculate the benefit premium.

A) 1410
B) 1432
C) 1455
D) 1478
E) 1500

Work Shown (4 points):

Hence the answer is (___)

END OF TEST PAPER