



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE**

**UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE**

**ACTUARIAL**

**4<sup>TH</sup> YEAR 1<sup>ST</sup> SEMESTER 2016/2017 ACADEMIC YEAR**

**MAIN REGULAR**

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**COURSE CODE: SAC 403**

**COURSE TITLE: ACTUARIAL LIFE CONTINGENCIES II**

**EXAM VENUE:**

**STREAM: (BSc. Actuarial)**

**DATE:**

**EXAM SESSION:**

**TIME: 2.00 HOURS**

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**Instructions:**

- 1. Answer question 1 (Compulsory) and ANY other 2 questions**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room.**

**QUESTION 1 [COMPULSORY] [30 Marks]**

(a) Explain what is meant by the following in respect of a life insurance policy;

(i) gross premium prospective reserve. **[6 Marks]**

(ii) gross premium retrospective reserve. **[6 Marks]**

(b) Describe how a life office can calculate the new sum assured or annual premium on the alteration or conversion of an existing policy. **[6 Marks]**

(c) Consider  ${}_tV_x$ , the reserve during  $t$  years for a whole life assurance to a life age  $x$ . Assuming death benefits are payable at the end of the year of death and ultimate mortality, show that the net prospective reserve and retrospective reserve are equal. **[8 Marks]**

(d)(i) In the context of profit-testing explain the difference between the profit vector and profit signature. **[4 Marks]**

(ii) A certain life office sells assurance policies with term 3 years to lives aged 70. For each policy, the profit vector is estimated to be  $(-50, 30, 30)$ . Given that the mortality of the policyholders expected to follow A1967-70 ultimate, calculate the profit signature per policy sold and the net present value of the profit the office (on the basis of a risk discount rate of 8%p.a).

**[8 Marks]**

**QUESTION 2[20 MARKS]**

(a) Define the following

(i) net premium reserves [2 Marks]

(ii) Zillmerised reserve [2 Marks]

(b) Ten years ago a life office issued a 20-year endowment assurance without profits to a life age 35. The sum assured is 100,000 payable at the end of the year of death (or on survival for 20 years), and premiums are payable annually in advance. The basis for premiums and reserves is;

A1967-70 ultimate;

6% p.a interest;

expenses are 3% of all office premiums (including the first) with additional initial expense of 1.5% of the sum assured. Calculate

(i) the annual premium. [4 Marks]

(ii) the reserve before the receipt of premium now due. [6 Marks]

(iii) the reserve after receipt of the premium now due. [6 Marks]

**QUESTION 3[20 MARKS]**

(a) Give formulae for the following net premium reserves in terms of other monetary functions:

$${}_tV_{x:\overline{n}|}$$

and

$${}_t\bar{V}(\bar{A}_{x:\overline{n}|})$$

by

(i) the prospective method and [5 Marks]

(ii) the retrospective method [5 Marks]

(b) Given  $P_x = 0.02$ ,  ${}_nV_x$  and  $P_{x:\overline{n}|}^1 = 0.25$ . Calculate  $P_{x:\overline{n}|}^1$  [4 Marks]

(c) Show that

$${}_1W_{\overline{n}|} = \frac{1}{\ddot{a}_{\overline{n}|}}$$

[6 Marks]

**QUESTION 4[20 MARKS]**

(a) Given that mortality profit in the policy year  $t + 1$  is

$$\sum_{all} ({}_tV + P)(1 + i) - \sum_{deaths} (S - {}_{t+1}V) - \sum_{all} {}_{t+1}V$$

Consider a single policy in the group and assuming that accumulated funds at the end of the year must provide for the expected cost of death claims

and the expected cost of setting up reserves for survivors as

$$({}_tV + P)(1 + i) = Sq_{x+t} + (1 - q_{x+t})_{t+1}V$$

Show algebraically that mortality profit is

$$E.D.S - A.D.S$$

[10 Marks]

(b) A 10 year “double endowment” assurance policy issued to a group of lives aged 50, a sum assured of Kshs.10,000 is payable at the end of the year of death and Kshs.20,000 is paid if the life survives to reach the maturity date. Premiums are payable annually in advance. You are given the following additional information

- Reserve at the start of the 8<sup>th</sup> year (per policy in force)-Kshs.12,940
- Number of policies at the start of the 8<sup>th</sup> year-200
- Number of deaths during the 8<sup>th</sup> year-3
- Annual premium per policy-Kshs.1,591

Assuming that the reserving basis uses ELT15(Males mortality and 4% interest, calculate the profit or loss arising from mortality in the 8<sup>th</sup> year and comment on your results.

[10 Marks]

**QUESTION 5[20 MARKS]**

Your office is considering the issue of 3-year annual-premium endowment assurance policies without profit to lives aged 62. In respect of a policy with sum assured Kshs.100,000, payable at the end of the year of death (if within 3 years) or on maturity, calculate the profit signature and the profit vector on the following assumptions

Premium basis:

- mortality- AM92
- interest- 6%p.a
- expenses-3% of all premiums

Reserving basis:

- rate of interest to be earned in the life fund -8% per annum
- expenses-3% of office premiums
- mortality-AM92
- risk discount rate-10% per annum

**[20 Marks]**