****

**GARISSA UNIVERSITY**

**UNIVERSITY EXAMINATION 2018/2019 ACADEMIC YEAR THREE**

**SECOND SEMESTER EXAMINATION**

**SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES**

**FOR THE DEGREE OF BACHELOR OF EDUCATION**

**COURSE CODE: ACS 301**

**COURSE TITLE: ACTUARIAL MATHEMATICS I**

**EXAMINATION DURATION: 2 HOURS**

**DATE: 07/02/2020 TIME: 2.00-4.00 PM**

**INSTRUCTION TO CANDIDATES**

* **The examination has FIVE (5) questions**
* **Question ONE (1) is COMPULSORY**
* **Choose any other TWO (2) questions from the remaining FOUR (4) questions**
* **Use sketch diagrams to illustrate your answer whenever necessary**
* **Do not carry mobile phones or any other written materials in examination room**
* **Do not write on this paper**

**This paper consists of FIVE (5) printed pages *please turn over***

**QUESTION ONE (COMPULSORY)**

1. Define the following terms
2. Underwriting
3. Selection
4. Graduation
5. Stationary Population (4 Marks)
6. A certain impaired life aged experience mortality according to AM92 ultimate with an addition to the force of mortality. The addition is at age 75, increasing linearly to at age
7. Find the formula for the probability that this life will be alive at age years (4 Marks)
8. Find the probability that this life dies between ages 80 and 90 (4 Marks)
9. Distinguish between
10. Positive selection and negative selection (2 Marks)
11. Over graduation and under graduation (2 Marks)
12. Define the present value of a random variable for a n – year term assurance contract that pays a sum assured of S on the death of (x) within the term and benefit payable at the end of the year of death and hence find the expression for finding the mean and variance of the present value (4 Marks)
13. State two reasons why graduated age distributions normally provide only plausible patterns or rough approximations of the expected age distribution (2 Marks)
14. The membership of a certain learned society is stationary at 11,500. Members enter only at exact age 50. They are subject to the mortality of English Life Table No.12 - Males, and there are no withdrawals. Find the annual number of entrants (4 Marks)
15. State two advantages and two disadvantages of graduation by a mathematical formula (4 Marks)

**QUESTION TWO**

1. Suppose that the life table function is given by for 0)
2. Compute the survival function for the new born lives [2 Marks]
3. Compute the survival function for the live currently aged 20 [4 Marks]
4. State the limiting age for the population [3 Marks]
5. You are given the following extract from a selected and ultimate mortality table with a 2- year select period [8 Marks]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | l[x] | l[x+1] | l[x+2] |  |
| 60 | 80,625 | 79,954 | 78,839 | 62 |
| 61 | 79,137 | 78,402 | 77,252 | 63 |
| 62 | 77,575 | 76,770 | 75,578 | 64 |

Assuming that death are uniformly distributed between integral ages, calculate

1. Most age distributions are usually corrected by methods of graduation or smoothing. State three aims of graduation [3 Marks]

**QUESTION THREE**

1. An insurer issues 25 year annual premium endowment insurance with sum assured Kshs. 100,000 to a selected life aged 35. The death benefit is payable immediately on death
2. Write down the gross future loss random variable (5 Marks)
3. Calculate the gross premium using AM92 mortality with 4% per year interest (5 Marks)
4. A large company has for many years maintained a staff in a stationary condition by recruiting 500 annual entrants at exact age 20, uniformly over the year. If the staff retire at age 60, there are no withdrawals, and English life table No- 12 mortality is experienced. Find
5. The size of the staff, (2 Marks)
6. The number of staff who retire each year, (4 Marks)
7. The number of pensioners. (4 Marks)

**QUESTION FOUR**

1. An impaired life aged exactly 55 wishes to effect a without profit endowment assurance for a sum assured of $1,000 payable at the end of 10 years or at the end of the year of earlier death. Level annual premiums are payable throughout the term of the policy. Special terms are offered on the assumption that the life will experience mortality which can be represented by:
2. For the first five years, a constant addition of 0.009569 to the normal force of mortality
3. For the remaining five years, the mortality of a life 8 years older.

The life office quotes a level extra premium payable throughout the term. Calculate this level

Extra premium. Basis:

Normal mortality: A1967-70 ultimate

Interest: 3% per annum

Expenses: none (8 Marks)

1. Each year for many years a life office has issued 10,000 temporary assurance policies each with a term of ten years and a sum assured of $5,000 to lives aged 25 exactly. One third of those who survive to age 35 then effect a without profits whole life policy for the same sum assured as the term policy, and one quarter effect a 25-year without profits endowment assurance for twice that sum assured. All premiums are payable annually in advance and death claims are paid at the end of the year of death. Policies are issued uniformly throughout the year. The office calculates premiums on A1967-70 ultimate 4%, ignoring expenses. If the office's experience follows this basis, calculate the size of the fund held for these contracts. (12 Marks)

**QUESTION FIVE**

1. Suppose a mortality table is represented by the function

Find

1. The probability of a newborn surviving to age 19 [3 marks]
2. The probability of a life aged 36 dying before attaining age 51 [3 marks]
3. The members of a large company's manual workforce are subject to three mode of decrement, death, withdrawal and promotion to supervisor. It is known that these workers' independent rates of mortality are those of English Life Table No. 12 - Males, the independent withdrawal rate is 0.04 at each age, and their independent promotion rate is 0.02 at age 50 and 0.03 at age 51.
4. Draw up a service table for manual workers from age 50 to age 51 with a radix of 100,000 at age 50, including the value of (*al*)52. [10 Marks]
5. Calculate the probability that a life aged exactly 50 will gain promotion within 2 years.

[4 Marks]