A. M. E. C. E. A

MAIN EXAMINATION

SEPTEMBER- DECEMBER 2020 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE

REGULAR PROGRAMME

ACS 406: LIFE CONTINGENCIES II

Date: DECEMBER 2020	Duration: 2 Hours
INSTRUCTIONS: Answer Question ONE and any other TWO Questions	

Q1   a) Differentiate between joint life status and last survivor status   **(4 marks)**

b) A special joint-life deferred annuity policy provides the following benefits:
- 20,000 is payable immediately on each death at any age
- a pension payable monthly in advance after 10 years at a rate of 10,000 per annum if both lives are alive and 5,000 per annum if only one life is alive

Premiums are payable monthly in advance until the first death for a maximum of 10 years. Show that the monthly premium payable for a male life aged 55 exact and a second female life aged 50 exact is approximately 1,114.

Basis:
First life mortality PMA92C20
Second life mortality PFA92C20
Rate of interest 4% per annum
Expenses Ignore   **(8 marks)**

c) Define and give the integrals of the following expressions

(i.) $\bar{A}\,xy^2$ **(2 marks)**

(ii.) $t\,q\,xy^2$ **(2 marks)**

(iii.) $\bar{a}\,x/y$ **(2 marks)**

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d.) The future lifetime of two lives (x) and (y) are independent and subject to a constant force of mortality of 0.05 and 0.06 respectively. Calculate the probability that their second death occurs after only 3 years but before 8 years.**(5 marks)**

e.) calculate the value of $q[55]:[60]$ for the independent lives using AM92 as your mortality table **(3 marks)**

f.) Why would a company keep reserves for joint life status lives for joint life assurance products? **(4 marks)**

Question Two (20 marks)

Q2 a) A life insurance company issues a reversionary annuity contract. Under the contract an annuity of Kshs 20,000 per annum is payable monthly for life, to a female life now aged 60 exact, on the death of a male life now aged 65 exact. Annuity payments are always on monthly anniversaries of the date of issue of the contract.

Premiums are to be paid monthly until the annuity commences or the risk ceases. Calculate the monthly premium required for the contract.

    Basis:
    Mortality: PFA92C20 for the female and PMA92C20 for the male
    Interest: 4% per annum
    Expenses: 5% of each premium payment
    1.5% of each annuity payment **(10 marks)**

b) A special joint life annuity is issued to a male life now aged 65 exact and a female life now aged 62 exact. The annuity is payable monthly in arrear and is subject to the following conditions:
    • The amount of the annuity while both lives survive is 100,000 per annum.
    • If the male life dies first leaving the female life surviving the annuity reduces to 50,000 per annum payable until she dies.
    • If the female life dies first leaving the male life surviving the annuity reduces to 75,000 per annum payable until he dies.
    • In addition, if either life is alive at the 10*th* and 20*th* anniversaries of the policy a cash lump sum of 20,000 is paid at each date.
Calculate the expected present value of the annuity.
    Basis:
    Mortality PMA92C20 and PFA92C20
    Interest 4% per annum
    Expenses Nil. **(10 marks)**

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Q3   a) On January 2017, a joint life insurance contract company issued a 10-year life Non-profit term assurance to two lives aged 50 exact. The sum assured of Kshs. 500,000 will be payable immediately on death of the first life. Calculate the expected present value of the contract using the PMA92C20 and PFA92C20 tables at an interest of 4 % per annum.   **(10 marks)**

b.) A life insurance policy for a male life aged 55 exact provides the following benefits:
- 50,000 is payable immediately on his death, if this occurs before the age of 65 exact.
- On survival to age 65 exact, a refund of 25% of total premiums paid without interest.
- On death of the male at any time, a pension of 5,000 per annum is payable monthly in advance to his widow (who is 5 years younger than him) for the remainder of her life, should she survive him. (This benefit is available throughout the lifetime of the male.)

The policy is funded by premiums payable annually in advance for five years, or until the death of the male life, if earlier.

      Basis:
Male mortality PMA92C20
Female mortality PFA92C20
Rate of interest 4 % per annum
Expenses Nil

Calculate, showing all your workings, the premium for this policy   **(10 marks)**

Q4   A life insurance company issues a special annuity to a male-aged 70 and a female aged 60 exact.   An annuity of Kshs 10,000 per year is payable monthly to a female provided that it survives for the next 10 years after the death of male. An annuity commences on monthly policy anniversary following the 10th anniversary after the death of male and is payable for the balance of the lifetime of female.

(i.)   Find the equation of value for the premium   **(4 marks)**
(ii.)   Hence, or otherwise, calculate the single premium required for the contract to be implemented   **(16 marks)**

      Basis:

      Mortality: PMA92C20 and PFA92C20 tables for two lives

      Interest: At 4 % per annum

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Q5   A life insurance company issues an annuity policy to two lives each aged 60 exact in return for a single premium. Under the policy, an annuity of Ksh.10, 000 per annum is payable annually in advance while at least one of the lives is alive.

(i.) Write down an expression for the net future loss random variable at the outset for this policy   **(4 marks)**

(ii.) Calculate the single premium, using the equivalence principle.

    Basis:

  Mortality PMA92C20 for the first life, PFA92C20 for the second life

  Interest 4% per annum

  Expenses ignored   **(8 marks)**

(ii.) Calculate the standard deviation of the net future loss random variable at the outset for this policy, using the basis in part (ii).

You are given that $a_{60:60}$ =11.957 at a rate of interest 8.16% per annum.

                   (8 marks)

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