

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

20th September 2017

**Subject CT5 – General Insurance, Life and
Health Contingencies**

Time allowed: Three Hours (10.30 – 13.30 Hours)

Total Marks: 100

INSTRUCTIONS TO THE CANDIDATES

- 1. Please read the instructions inside the cover page of answer booklet and instructions to examinees sent along with hall ticket carefully and follow without exception.*
- 2. Mark allocations are shown in brackets.*
- 3. Attempt all questions, beginning your answer to each question on a separate sheet. However, answers to objective type questions could be written on the same sheet.*
- 4. Please check if you have received complete Question Paper and no page is missing. If so, kindly get new set of Question Paper from the Invigilator.*

AT THE END OF THE EXAMINATION

Please return your answer book and this question paper to the supervisor separately.

- Q. 1)** Calculate: (2)
- i) $s_{55:\overline{10}|}$
- ii) $\ddot{a}_{[40]:\overline{20}|}^{(4)}$ (2)
- Basis:
Mortality AM92
Rate of interest 6% per annum [4]
- Q. 2)** Define μ_x , K_x and T_x . [3]
- Q. 3)**
- i) Briefly explain the difference between Net premium reserves and Gross premium reserves. (2)
- ii) For a with profit product, list the main components of Gross premium (Office premium). (2)
- iii) A company calculates the Gross premium reserves for its' with profit products without any allowance for future bonuses. Comment on suitability of such reserves. (2)
- [6]
- Q. 4)** An special endowment assurance policy is issued to a male life aged 45 years exact for a term of 20 years. The policy has a sum assured of Rs. 2,500,000 payable immediately on death if it occurs within the term. A maturity benefit of Rs. 1,000,000 is paid if the policyholder survives till the end of policy term.
- Calculate the expected present value and the standard deviation of the benefit outgo. We can assume expenses to be NIL and a rate of interest of 5% per annum. A constant force of mortality with $\mu_x = 0.025$ across all ages is also assumed. [8]
- Q. 5)** A Life Insurance company issues immediate annuity policies to lives aged 60 years exact. An annual annuity payment of Rs. 500,000 is paid on survival at the end of every policy year.
- The company calculates the premium using following assumptions:
- Mortality: PMA92C20
Interest rate: 4% pa
Expenses:
Initial expense: 5% of single premium
Renewal expense: Rs. 200 at start of every year from 2nd year onwards.
- Calculate the minimum single premium the company should charge so that the probability of loss is less than 10 per cent. [8]

Q. 6) A life Insurance company sells the following set of policies on 1st January 2007.

-- 10,000 regular premium term assurance policies with a policy term of 25 years, to male lives then aged 40 years exact. The level sum assured under the policy is Rs. 2,500,000 and is paid at the end of year of death. Annual premiums are paid annually in advance.

-- 10,000 single premium immediate annuity policies to male lives then aged 50 years exact. An annual annuity payment of Rs. 250,000 is paid on survival at the end of every policy year.

As on 31st December 2016, out of 10,000 term insurance policies only 8,500 are in-force, whereas 9,900 of immediate annuity policies are in-force.

- i)** Explain, what can be the possible reasons of difference between the counts of in-force policies for the two types of products as on 31st December 2016, given the same count of policies originally issued. (2)

The company calculates the net premium reserves for above products, using the following assumptions: Mortality - AM92 Ultimate for the term assurance and PMA92C20 for immediate annuity and interest rate of 4% per annum.

- ii)** Calculate the total reserves in-force for the above portfolio as at 31st December 2016. (6)
- iii)** As part of the annual regulatory submission, the company has to develop an analysis of surplus report. List the possible sources of surplus for a Life Insurance company. (2)

During the last year, i.e. 1st January 2016 to 31st December 2016, 5 deaths have happened in the term assurance portfolio, whereas only 4 deaths have happened in the annuity portfolio. Also, there has been no other form of decrement seen during the year.

- iv)** Calculate the mortality profit for the period 1st January 2016 to 31st December 2016, for the combined portfolio. (6)

[16]

Q. 7) A Joint life annuity is issued to X (65 Male) and Y (60 Female). As part of this annuity Rs. 1,000,000 per annum is paid continuously commencing from first death and continuing till the second death. Post second death, Rs. 200,000 per annum is paid continuously for next 5 years. Calculate the expected present value of the benefit using:

Mortality PMA92C20 (male life), PFA92C20 (female life)

Rate of interest 4% per annum

Expenses Nil

[6]

- Q. 8)** A single premium contract of term one year is sold to a life aged 40 exact at entry which makes a payment of Rs 20,000 on death from accident or Rs. 10,000 on death from any other cause. Additionally, Rs 5000 is payable at maturity if the life survives till the end of the term. Surrender is allowed to be made only at the middle of a policy year. A surrender value equal to 70% of the single premium is given immediately at the time of surrender.

Calculate the single premium to be charged for the contract using the equivalence principle.

Assumptions:

Force of decrement due to accidental death from age 40 to 41: 0.002

Force of decrement due to death from any other cause from age 40 to 41: 0.03

Probability of surrender at exact age 40.5 = 15%

Interest: 3% per annum compound

Commission: 2% of Single Premium

Claim related expenses: 1% of claim amount (Deaths, Maturity and Surrender)

State any further assumptions you make.

[10]

- Q. 9)** i) In the context of a Pension Scheme, define the following:

a) Accrued Benefit

b) Future Service Benefit

c) Prospective Service Benefit

(3)

- ii) A pension scheme defines Final pensionable salary as the annual average earnings over the three years immediately prior to retirement. Normal Retirement Age is 65 exact. The pension scheme is about to perform its annual valuation as at 31/03/2017.

Mr. EMPLOYEE, whose date of birth is 01/04/1975, joined the pension scheme on 31/03/2000. He has earned Rs. 5,00,000 in the immediately preceding 12 months.

Using the functions and symbols defined in, and assumptions underlying, the Example Pension Scheme Table in the Actuarial Tables, calculate the expected present value of each of the following benefit available to Mr. EMPLOYEE:

a) A pension on ill-health retirement of one-third of final pensionable salary.

(3)

b) A pension on retirement at any stage on grounds other than ill-health of one-tenth of final pensionable salary for each year of service (fractions of a year counting proportionately), subject to a maximum of 35 years.

(3)

c) A lump sum on retirement at any age for any reason of Rs. 10,00,000.

(2)

[11]

Q. 10) A four-year unit-linked endowment policy is sold to a life aged 50 exact. Level regular annual premiums of Rs. 25,000 are payable throughout the policy term. 70% of the first years' premium and 110% of each subsequent years' premiums are invested in the unit fund. The bid price of the units is 90% of the offer price. The company deducts a Fund Management Charge of 0.50% of the value of the policyholders' fund and a Policy Administration fee of Rs. 500 at the end of each year. The death benefit, which is payable immediately on death, is the bid value of the units subject to a minimum of Rs. 65,000. The maturity value is equal to the bid value of the units. The insurance company incurs an initial expense of Rs. 3,500 at the start of the first year and renewal expenses of Rs. 1100 in the subsequent years.

Basis: Mortality probability of 0.015 at each age.

Withdrawals to be ignored.

Unit growth rate and Non unit interest rate of 7% p.a.

- i) Assuming that the insurance company holds unit reserves equal to the value of units and zero non-unit reserves, calculate the expected profit emerging in each policy year. (10)
- ii) Calculate the revised profit emerging each year assuming that the office sets up non-unit reserves to ensure that the expected profit emerging in the second and subsequent policy years is non-negative. (9)

[19]

Q. 11) Explain the following types of selection:

- a) Temporary initial selection
- b) Class selection
- c) Time selection
- d) Adverse selection
- e) Spurious selection

[5]

Q. 12) State the different classes of lives and explain the various selection that is present in a pension fund. [4]
