

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

4th November 2015

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

Time allowed: Three Hours (10.30 – 13.30 Hrs)

Total Marks: 100

INSTRUCTIONS TO THE CANDIDATES

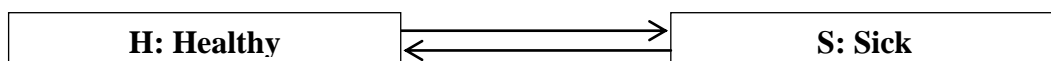
- 1. Please read the instructions on the front page of answer booklet and instructions to examinees sent along with hall ticket carefully and follow without exception*
- 2. Mark allocations are shown in brackets.*
- 3. Attempt all questions, beginning your answer to each question on a separate sheet. 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
- a) ${}_{10}p_{45}$
b) ${}_{10|10}q_{40}$
c) $\ddot{a}_{55:10|}$
- Basis:
Mortality AM92
Rate of interest: 6% per annum [3]
- Q. 2)** An insurance company offers an increasing term assurance that provides a benefit payable at the end of the year of death of INR 50,000 per month in the first year, increasing by INR 2,500 per month on each policy anniversary.
- Calculate the single premium for a five year policy issued to a life aged 50 exact.
- Basis:
Mortality: AM92 Select
Rate of interest: 6% per annum
Expenses: Nil [6]
- Q. 3)** Describe the use of terminal bonus within the reversionary bonus system. [5]
- Q. 4)** Define the following terms for a single whole life policy:
- a) Death Strain at Risk
b) Expected death strain
c) Actual death strain
d) Mortality profit [7]
- Q. 5)** A 25 year temporary annuity-due of INR 120,000 per annum is issued to a life aged 50 exact. Express the expected present value of the annuity in terms of an assurance function and calculate its value.
- Basis:
Mortality: AM92 Select
Rate of Interest: 6% per annum [4]
- Q. 6)** A pension annuity for a retired employee provides a monthly payment in arrear to a life now aged 60 exact where each monthly payment is 1.002328 times greater than the one immediately preceding it. The first monthly amount is INR 10,000.
- Calculate the expected present value of the annuity using the following basis:
Mortality: AM 92 Ultimate
Rate of Interest: 9% per annum [4]

- Q. 7)** Discuss the suitability of the crude death rate, the standardized mortality rate and the standardized mortality ratio for comparing:
- i) The mortality, at different times, of the population of a given country (3)
- ii) The mortality, at a certain time, of two different occupational groups in the same population (3)
- Q. 8)** A population is subject to two modes of decrement, α and β . In the single decrement tables:
- $$\mu_x^\alpha = 1/(100-x) \quad \text{for } 0 \leq x < 100; \text{ and}$$
- $$\mu_x^\beta = 0.02 \quad \text{for } 0 \leq x < 100$$
- Calculate the value of $(aq)_{50}^\beta$. [6]
- Q. 9)** Describe the benefits typically provided by a salary-related pension scheme for active members on age retirement. [6]
- Q. 10)** An annuity is payable continuously in respect of a male and female life each aged 65 exact as follows:
- INR 100,000 per annum commencing immediately and payable till the first death;
 INR 50,000 per annum commencing on the first death and payable till the second death; and
 INR 25,000 per annum commencing on the second death and payable for 10 years.
- Calculate the expected present value of the annuity given the following basis:
- Mortality: PMA92C20 for the male and PFA92C20 for the female
 Interest: 4% per annum
 Expenses: Nil [6]
- Q. 11)** Calculate the probability of survival to age 60 exact using AM92 Ultimate for a life aged 54½ exact using two approximate methods. State any assumptions you make. [6]
- Q. 12)** A life insurance company uses the following model for a 1-year sickness policy issued to healthy policyholders.



In return for level monthly premiums payable in advance during the policy term, the life insurance company will pay the following benefits:

- INR 10,000 payable at the end of the month for each month in which the policyholder is sick at the end of the month.
- Additionally, if the policyholder is sick at the end of any month, the premium paid at the start of that month is returned to the policyholder at the end of the month.

Let S_t represent the state of the policyholder at the end of month t , so that $S_0 = H$ and for $t = 1, 2, 3, \dots, 12$, $S_t = H$ or S . The monthly transition probabilities are defined as follows:

$$p_t^{ij} = P(S_{t+1} = j | S_t = i)$$

For $t = 1, 2, 3, \dots, 12$, it is assumed that

$$p_t^{HH} = 0.5, p_t^{HS} = 0.5, p_t^{SS} = 0.5, p_t^{SH} = 0.5$$

It is also assumed that transitions from healthy to sick state and vice-versa can only happen at the middle of the month. Calculate the least monthly premium required to ensure that the probability that the present value of loss is positive does not exceed 25%.

Basis:

Mortality:	Nil
Initial expenses:	INR 1,000 and 10% of the monthly premium at policy commencement
Renewal expenses:	INR 100 and 1% of the monthly premium at the end of each month
Interest rate:	0% per annum

[11]

Q. 13) A life insurance company is designing a special endowment product in order to meet its obligations towards the rural sector. The features of the product are as follows:

Policy term:	3 years
Single premium:	INR 500 payable at commencement of policy
Death benefit:	INR 5,000 payable at the end of the year of death in the event of death within the policy term
Maturity benefit:	INR 750 payable at the end of the policy term in the event of survival till the end of the policy term
Surrender benefit:	INR 575 and 650 payable at the end of policy years 1 and 2 respectively

The pricing basis is as follows:

Interest:	8% per annum
Mortality:	100% of ELT15
Surrender rates:	5% of all policies in force at the end of year 1 5% of all policies in force at the end of year 2
Expenses:	Nil
Risk discount rate:	8% per annum

The company intends to set up prospective reserves at the end of policy years 1 and 2 using the following valuation basis:

Valuation interest:	5% per annum
Valuation mortality:	150% of ELT15
Valuation surrender rates:	Nil
Valuation expenses:	Nil

- i) Calculate the expected present value of the profit for a policy issued to a male life aged 40 exact. (12)
- ii) State with reasons, what the effect on the expected present value of profit for this policy would be, if:
- a) Pricing basis surrender rate assumption at the end of policy year 1 is increased. (2)
- b) Valuation interest rate assumption is increased. (2)
- [16]**

Q. 14) A life aged 30 exact purchases a 35-year with-profit endowment assurance policy. Level premiums are payable monthly in advance throughout the duration of the contract. The sum assured of INR 500,000 plus declared reversionary bonuses are payable at maturity or at the end of the year of death if earlier.

- i) Calculate the monthly premium if the life insurance company assumes that future simple reversionary bonuses will be declared at the rate of 4% per annum and vesting at the end of each policy year (i.e. the death benefit does not include any bonus relating to the policy year of death).

Basis:

Mortality: AM92 Select

Interest: 6% per annum

Initial expenses: INR 12,500 plus 50% of the gross annual premium

Renewal expenses: 3% of the second and subsequent monthly premiums

Claims expenses: 15000 on death; Nil on maturity

(7)

- ii) At age 60 exact, immediately before the premium then due, the life wishes to surrender the policy. The life insurance company calculates a surrender value equal to the gross retrospective policy value, assuming the same basis as in (i) above.

Calculate the surrender value using the retrospective policy value at the end of the 30th policy year immediately before the premium then due and just after the declared bonus has increased the sum assured plus reversionary bonuses. Assume that the life insurance company has declared a simple bonus throughout the duration of the policy consistent with the bonus loading assumption used to derive the premium in (i) above.

(7)

[14]
