(2½ Hours) [Total Marks : 75

N. B. : (1) All questions are **compulsory**.

(2) **Figures** to the **right** indicate **full** marks.

(3) Use of calculators is allowed.

1. (a) Define (i) Curtate expectation of life 8

(ii) Complete expectation of life

Prove in usual notation.

(i)
$$e_x = \frac{\sum\limits_{t=1}^{\infty} l_{x+t}}{l_x}$$

(ii) $$_np_x = \pi_{i=0}^{n-1} \frac{e_{x+i}}{1+e_{x+i+1}}$$

(b) Explain the concept of 'Select Tables' as used in Mortality tables. How 7 are these different from Aggregate tables? Also, define 'period of selection'.

OR

1. (p) Define (i) Force of Mortality 8

(ii) Central Mortality rate

Show that $\mu_{x+\frac{1}{2}} = m_x$

(q) Of two persons A (aged 35) and B (aged 42) find the probability that 7

(i) A and B both survive 10 years

(ii) A and B both die within 10 years

(iii) One of the two lives survives 10 years while the other dies within that period

(iv) At least one survives 10 years.

Given that $l_{35} = 973550$, $l_{45} = 946656$

$l_{42} = 957541$, $l_{52} = 904837$

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2. (a) Define (i) Immediate Annuity Certain   7
            (ii) Deferred Annuity Certain Due.
        Obtain the expression for the present value of an annuity of Re. 1 p.a.
        where the payments are made at the beginning of each year for n years.
        Hence obtain its accumulated value.
   (b) Prove the following in usual notations   8

$$(Ia)_{\overline{n}|} = a_{\overline{n}|} + \frac{a_{\overline{n}|} - n\upsilon^n}{i}$$

OR

2. (p) Derive the present value of an immediate annuity certain for n years   8
        where the payments of 'r' are made at each interval of r years.
   (q) Explain the nominal rate of interest and effective rate of interest. Obtain   7
        the relationship between them.

3. (a) Derive the expression for the present value of life annuity due of Re.   7
        1 p.a. payable to a peson aged x, in terms of commutation functions.
   (b) Explain the concept of temporary life annuity. Obtain, in terms of   8
        commutation functions, the expression for the present value of
        immediate temporary life annuity payable to a person aged x.
OR
3. (p) Obtain the present value of increasing life annuity when the payments   8
        are made at the end of each year to a person aged x. Write the result
        in terms of commutation functions.
   (q) Derive the expression for the present value of deferred life annuity due 7
        of Re. 1 p.a. payable to a person aged x in terms of commutation
        functions.

4. (a) Explain the terms :   4
        (i) Whole life assurance
        (ii) Endowment assurance
   (b) Obtain the expression for level annual premium for Temporary   11
        assurance in terms of commutation functions after deriving all the
        necessary results.
OR
4. (p) What are premiums? Explain the concept of single premium and level   5
        annual premium.

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(q) Obtain the present value of Pure Endowment assurance plan. Derive the level annual premium for the same in terms of commutation functions.   10

5. (a) Define (i) $_np_x$ (ii) $_nq_x$ (iii) $_m|q_x$ 8
(iv) $_m|_nq_x$
Prove that $_np_x = p_x \, p_{x+1} \, p_{x+2} \cdots p_{x+n-1}$
& $_m|_nq_x = {}_mp_x - {}_{m+n}p_x$

(b) Consider loan of sum $a_{\overline{n}|}$ is to be repaid in n equal instalments. Obtain the expression for   7
(i) the interest component contained in m^{th} instalment (m < n)
(ii) principal outstanding after m^{th} instalment.

OR

5. (p) Explain the concept of limited payment assurance with the help of Endowment assurance plan. Derive the level annual premium for the same in terms of commutation functions.   8

(q) Prove that $_m|a_{\overline{n}|} = a_{\overline{m+n}|} - a_{\overline{m}|}$ after deriving the expression for $_m|a_{\overline{n}|}$.   7

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