ASSOCIATESHIP/FELLOWSHIP EXAMINATION
FOUNDATIONS OF ACTUARIAL SCIENCE (LIFE INSURANCE)

Time : 3 Hours ] [ Total Marks : 100

Answer EIGHT questions only. Question number TEN carries 16 marks but this is not compulsory.
All other questions carry 12 marks each.

Q.1. Answer any three :

(a) Briefly explain the various methods that can be used for comparing two Mortality Tables.
(b) Describe the relative advantages and disadvantages of the Policy Year Method as against Life
Year Method and Calendar Year Method.
(c) Define: \( e_x \) and \( e_x^* \)
Give relation between them.
(d) Write a Short Note on ‘Level Annual Premium’.

Q.2. Give name and Commutation Functions for Present Values for following Expressions :

(a) \( (1A)_x \)
(b) \( t\vec{A}_x \)
(c) \( t\vec{A}_{x\overline{m}} \)
(d) \( \ddot{a}_{x\overline{m}} \)

Q.3. Using Commutation Functions based on IALM (94-96) Modified Ultimate Mortality Table
at 6% Interest calculate for a Person aged 40:

(a) The Present Value of Whole Life Assurance of ₹ 10,000/-
(b) The Present Value of Double Endowment Assurance of ₹ 10,000/- for 15 Years’ Term.
(c) The Present Value of Endowment Assurance of ₹ 10,000/- for 15 Years’ Term.
(d) The Present Value of Pure Endowment of ₹ 10,000/- for 15 Years’ Term.
Show that the sum of two values (c)+(d) is equal to the Present Value of
Double Endowment Assurance.

Q.4. The Probability of a Person aged 22 surviving one year is .9, and the Probability that a Person aged 23
survives one year is .89. Find the Probability that of two Persons, Ram and Rani aged 22 and 23
respectively, (Any Two)

(a) Both survive one year,
(b) At least one survives one year,
(c) At least one dies in one year.
Q.5. Any two of the following: 6 Each
   (a) What is the Benefit that is presented by $a_{x\:\overline{n}\:\overline{i}} - a_{x\:\overline{n}\:\overline{i}}$? Also, interpret the result.
   (b) Explain the use of Commutation Functions.
       Explain how Commutation Functions: $D$, $C$, $M$, and $R$ can be derived for a given
       Mortality Table at desired Rate of Interest.
   (c) Establish algebraically the relationship $p_{x\:\overline{n}} - p_{x\:\overline{n}} = q_{x} \cdot p_{x\:\overline{n+1}}$

Q.6. Write short notes with Commutation Functions of Any Two of following: 6 Each
   (a) Increasing Life Annuity,
   (b) Deferred Temporary Life Annuity (Payments are made at the end of each year),
   (c) Temporary Immediate Life Annuity (Payments are made at the end of each year).

Q.7. Establish following relationship, Mathematically: 6 Each
   (a) $(\overline{a}_{\overline{n}}) = \frac{\overline{a}_{n} - n v^{n}}{d}$
   (b) $S_{\overline{p}} = S_{\overline{n}} \times \frac{e^{r}}{e^{r(n+1)}}$

Q.8. A Loan of ₹ 2,000/- is to be paid by means of an Annuity payable Half-Yearly over 10 Years, with
     Interest @8% p.a. convertible Half-Yearly, the first payment is due at the end of six months from now.
     Calculate the value of ‘A’ and give the value of Half-Yearly Payment in last three Years and Value of
     Outstanding Loan at the end of 7th Year.

The Amount of Half-Yearly Payments are as follows: 12

<table>
<thead>
<tr>
<th>Year</th>
<th>Half-Yearly Payments (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-7</td>
<td>100</td>
</tr>
<tr>
<td>8</td>
<td>100+A</td>
</tr>
<tr>
<td>9</td>
<td>100+2A</td>
</tr>
<tr>
<td>10</td>
<td>100+3A</td>
</tr>
</tbody>
</table>
Q.9. Calculate the Net Annual Premium for a Life aged 25 in each of the under mentioned cases:
   a) Endowment Assurance of 20 Years, Premiums Limited to 10 Years.
   (b) A 20-Years’ Assurance under which the Benefit on death during the Term is twice that payable on Survival to the end of Term.
   (c) A Deferred Temporary Assurance which is to commence at Age 30 and then to continue for 10 Years.
The following Commutation Functions are given:
   \( N_{25} = 1040000 \)
   \( N_{35} = 637000 \)
   \( N_{40} = 482100 \)
   \( N_{45} = 353300 \)
   \( D_{25} = 22870 \)
   \( M_{25} = 16470 \)
   \( M_{30} = 15540 \)
   \( M_{40} = 13720 \)
   \( M_{45} = 12580 \)

Q.10 (a) Find the Amount of ₹ 1,000/- at the end of 10 Years:
   i) At the Nominal Rate of Interest of 12% per annum convertible Quarterly.
   ii) At Effective Rate of Interest of 3% per Half Year.
   (b) ‘A’ is entitled to the following Benefits:
      i) Five Annual Payments at the Rate of ₹ 200/- p.a., the first being due at the end of one Year from now.
      ii) Thereafter, six Annual Payments at the Rate of ₹ 300/- p.a., the first of these being due at the end of 11 Years from now.
      iii) An additional lump sum Payment of ₹ 2,000/- at the end of 10 Years.
      Find the Present Value of his Benefits at the Rate of Interest of 6% p.a.
   (c) Given that:
      \( A_x = 0.3801 \) and \( P_x = 0.0211 \)
      Find \( a_x \) and the Rate of Interest.

END
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