IC-104

Fellowship

EXAMINATION QUESTION PAPERS MAY 2005

भारतीय बीमा संस्थान
INSURANCE INSTITUTE OF INDIA
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Mumbai - 400 001.

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FL-81

FELLOWSHIP EXAMINATION

MATHEMATICAL BASIS OF LIFE ASSURANCE

Time: 3 Hours] [Total Marks : 100

Answer any **FIVE** questions only.
All questions carry 20 marks each.

Marks

1. a) Prove both by general reasoning and algebraically that :- 7

$$\frac{1}{a_{\overline{n}|}} = \frac{1}{s_{\overline{n}|}} + i$$

b) An invester deposits Rs. 20,000 in a savings account in a bank and then withdraws uniform annual amount starting one year after the deposit was made. Immediately after the 11th annual withdrawal, the investor has left Rs. 4,000 in the account. Calculate the uniform amount of the withdrawal, assuming the bank allows interest at 8% per annum. 5

Given: $a_{\overline{11}|}$ at 8% = 7.1390

c) A loan is repayable by 15 equated yearly instalments of Rs. 2,750 each, comprising both interest and capital. The rate of interest on loan is 7% per annum effective. Calculate :

i) The amount of loan. 2

ii) loan outstanding immediately after the 5th yearly instalment is repaid. 2

iii) loan oustanding immediately before the 5th instalment is repaid. 2

iv) total interest paid during the first 5 years. 2

Given at 7% : V^5 = .71299 V^{10} = .50835 V^{15} = .36245

2. a) Under a settlement of property Mr. A is entiltled to Rs. 6,000 per annum ad infinitum, the first payment being due at the end of 2 years. Find the present value of Mr. A's right at 6% p.a. interest. 4

b) A life insurance company calculates single premium for immediate annuity certain policies using effective rate of interest of 6% per annum:

i) Calculate the net single premium for an immediate annuity of Rs. 3,200 per annum payable quarterly in arrears for 10 years certain only. 4

ii) Calculate the prospective policy value and the retrospective policy value under (i) above at the end of 5 years immediately after payment of the instalment then due, using 6% p.a. interest. 6

iii) Calculate the office single premium under (i) above allowing for initial expense of 2% of the office single premium, and expenses relating to payment of annuity at the rate of Rs. 20 per instalment. 6

Given at 6% : $V^5 = .74726$ $V^{10} = .55839$

$s_{\overline{5}|} = 5.6371$ $i^{(4)} = .058695$

3. a) If $l_x = 100 - x$, Find the value of $A^{\frac{1}{46}}_{46:\overline{15}|}$ at 5% interest, 5

Given that V^{15} at 5% = .4810

b) If $A_{45} = .24$, $A_{55} = .36$, $A_{45:\overline{10}|} = .57$, 7

Calculate the values of :

i) $A_{45:\overline{10}|}$ ii) $A^{\frac{1}{45}}_{45:\overline{10}|}$ iii) $10|A_{45}$

c) A student has written the following equations : 8

i) $n|A_x = V^n \times A_{x+n}$

ii) $\ddot{a}_x = \ddot{a}_{\overline{n}|} + n|\ddot{a}_x$

iii) $A_{x:\overline{n}|} = A_{x:\overline{t}|} + \frac{D_{x+t}}{D_x} \times A_{x+t:\overline{n-t}|}$

State whether each equation is correct or not, and wherever applicable, write the corrected equation.

4. a) Sometimes where no standard mortality table has been produced for female lives, actuaries use the corresponding male table, but apply an age rating of 4 years (say), that is they consider a female aged x to be equivalent to a male aged $x-4$. Explain the rationale underlying this approach. 3

b) A life aged 60 is assumed to be subject to rate of mortality equal to twice that of the LIC (1994-96) ultimate mortality. Calculate the probability that the life will die before age 62. 5

Given as LIC (1994-96) ultimate mortality :

$q_{60} = .013073$ and $q_{61} = .014391$

c) Complete the entries in the following portion of a mortality table. 6

Age (x)	l_x	d_x	p_x	q_x
51	63,000	---	---	.005
52	---	---	---	.006
53	---	---	---	.007
54	---	---	---	.008

d) On the basis of the mortality table in (c) above, calculate the probabilty that :

i) A life aged 52 will survive to age 54. 2

ii) A life aged 51 will die after age 52 but before age 54. 2

iii) Of three lives all aged 51, at least one life dies before age 52. 2

5. a) A debenture bearing interest at 6% per annum payable quarterly in arrear is redeemable at par at the end of 5 years. Find the price an investor of the debenture of nominal Rs. 10,000 should pay if he desires to realise a net yield of 5% per annum. The investor is subject to tax on interest income at 20%. 5

Given at 5% : $V^5 = .78353$ $i^{(4)} = .049089$

b) A student has correctly written expression for office annual premium under a policy as under :

$$\text{Office Annual Premium} = \frac{20{,}000\,(A40 : \overline{20|} + A40 : \overline{20|}^{1})}{\cdot 95\,\ddot{a}\,40 : \overline{15|} - \cdot 65}$$

i) What benefits are payable on death of the life assured during the policy term, and on his survival to maturity? 3

ii) What are the expense loadings? 6

iii) What is the period during which premiums are payable? 2

c) Explain why the crude mortality rates should be graduated? 4

6. a) Prove that $\ddot{a}_{x:\overline{n}|} - a_{x:\overline{n}|} = 1 - A^{\frac{1}{}}_{x:\overline{n}|}$ 5

b) Prove that $a_x = Vp_x \times \ddot{a}_{x+1}$ 5

c) What is a "solvency valuation"? 5

d) Write short note on interim bonus. 5

7. a) Calculate for a life aged 40 :

i) the net single premium for a 15-year temporary assurance for Rs. 10,000. 5

ii) The net annual premium limited to 20 years for a whole life assurance for Rs. 25,000 5

iii) The net annual premium for a double endowment assurance for 15 years for a basic sum assured of Rs. 20,000. 5

The following values are given:

x	D_x	M_x	N_x
40	93645	17625	1343015
55	35573	12716	403807
60	24604	10506	249057

b) What is the rationale for creating a reserve for early payment of claims? 5

8. a) Five years ago a life insurance company issued a whole life policy for sum assured of Rs. 40,000 on the life of a person then aged 30. Annual premiums were payable for 25 years or till death whichever is earlier. The person now desires the policy to be altered to an endowment assurance for sum assured of Rs. 30,000 maturing at age 55. Find the revised annual premium payable till age 55 or death, whichever is earlier. 12

Given at 6% interest : $\ddot{a}_{30} = 15.618$, $\ddot{a}_{35} = 15.052$

$\ddot{a}_{30:\overline{25}|} = 13.253$, $\ddot{a}_{35:\overline{20}|} = 11.864$

b) What are the advantages of reversionary bonus system? 8

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