IC-104

Fellowship

EXAMINATION QUESTION PAPERS MAY 2006

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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) Find the accumulated value of Rs. 3,000 for a period of 15 years 3 months @ 8% p.a. by using two different methods :- 6

Given :-

$(1.08)^{15} = 3.17217$ $(1.08)^{14} = 2.93719$

$(1.08)^{16} = 3.42594$ $(0.08)^4 = 0.077706$

b) 'A' has taken a certain loan at a rate of interest of 8% p.a. payable quarterly. He repaid Rs. 600 after 2 years, Rs. 800 after a further 2 years and cleared all outstanding dues of Rs. 1200 at the end of 5th year from the commencement of the transaction. 4

What is the loan amount taken by him ?

Given :-

$(1.02)^{20} = 1.48595$ $(1.02)^{10} = 1.21899$

$(1.02)^{12} = 1.26824$ $(1.02)^8 = 1.17166$

$(1.02)^4 = 1.08243$ $(1.02)^6 = 1.12616$

c) Explain the term 'Perpetuity' and prove algebraically 10

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

2. a) A purchaser of an irredeemable debenture gets a dividend of 2% every quarter. What should be the purchase price in order to yield an effective rate of 10% p.a. ? 4

Given :-

$i^4 = 0.09645,$ $(1.10)^{1/4} = 1.024114$

b) A life office issues capital redemption policies on the basis of an interest rate of 8% . First year expense loading of 2½‰ S. A. and 6% of premium and renewal expenses of 1‰ S. A. and 1½% of premium. Calculate the S. A. of policy if office annual premium is Rs. 432.15 for a term of 20 years. 10

Given that :-

$$d = 0.074074 \quad V^{20} = 0.21455; \quad V^{10} = 0.46319$$

c) Establish algerbraically the relationship 6

$$\frac{Tx}{l_x} = 0.5 + e_x$$

a) Find the probability that amongst three joint lives all aged x. 8

i) Any 2 of them will die in the $(t+1)^{th}$ year and the third one will survive $(t+1)$ year.

ii) Any one of them will die in the $(t+1)^{th}$ year and the remaining two will survive $(t+1)^{th}$ year.

b) Explain the terms 'selection' and 'select rates' with an example. 6

c) Describe Policy year method of mortality investigation and enumerate its advantages over other year method. 4

d) Name the various methods which can be used for comparing two mortality tables. 2

a) Calculate ignoring expenses and interest at 6% 10

i) The value of a Deferred Temporary Assurance of Rs. 5,000 payable to a person aged 25, for 5 years the deferment period being 3 years.

ii) The value of a Deferred whole life Assurance of Rs. 5,000 payable to a person aged 30, the deferment period being 5 years.

Given :-

$v^{25} = 0.23300$	$v^{30} = 0.17411$	$v^{35} = 0.13011$
$l_{25} = 987095$	$l_{30} = 980776$	$l_{35} = 973550$
$C_{25} = 277.62$	$C_{30} = 215.50$	$C_{35} = 212.71$
$M_{26} = 20763.69$	$M_{31} = 19586.09$	$M_{33} = 19166.13$
$M_{28} = 20259.52$	$M_{35} = 18747.99$	

b) Prove that : $A_x - A_{x:\overline{t}|}^{1} = \frac{C_x + M_{x+t+1}}{D_x}$ 4

c) In a pension policy of insurance the Sum Assured is Rs. 20,000 the rate of interest is 6% A temporary life annuity of Rs. 1,600 p.a. is payable for 20 years by quarterly instalments of Rs. 400 at the beginning of each month to a person aged 35 years. Calculate the present value of this annuity. 6

Given :-

$a_{35:\overline{20}|} = 11.1446$ $a_{35:\overline{19}|} = 10.8637$

5. a) Explain why natural premium system of insurance is unsuitable or unworkable. 5

b) A life insurance company issues a policy to a person aged 30 years for sum assured of Rs. 25,000 and term of policy 25 years. As per policy conditions if the policy holder survives for 25 years, then only sum assured is payable on maturity but in case if he dies within term of the policy then immediately a Death Claim equal to sum assured is paid on death and then again another sum assured is paid on the maturity date of the policy. On death premium payment for remaining term will get ceased. Calculate the net annual premium of this policy with rate of interest at 6% . Ignore expenses. 10

Given :-

$\ddot{a}_{30:\overline{20}|} = 13.253$ $v^{25} = 0.23300$

$M_{30} = 19801.54$ $M_{55} = 12716.28$

$N_{30} = 2666994.53$ $N_{55} = 403807.17$

c) Why surrender value of a policy is much less than its theoretical equivalent

6. a) Calculate the net single premium for an immediate annuity of Rs. 1000 per annum payable quarterly in arrears for 20 years certain and thereafter for life to a person aged 50 at entry.

Given :- at 6% interest

$a_{\overline{20}|} = 11.4699$ $(0.06)^4 = 0.05869$

$D_{70} = 10008.94$ $D_{50} = 49929.83$

$a_{70} = 6.708$

b) Explain the term 'mortality loading'. 5

c) What is the necessity for Adequacy and consistency of premium rates for various classes of policy holders? 10

7. a) Calculate office annual premium for a with profit whole life Assurance for S. A. of Rs. 50,000 to a person aged 35. Provide for first year expenses at 60% of premium and 15‰ sum assured and renewal expenses of 5% of premium and 6‰ sum assured. Also make provision for bonus loading of Rs. 30‰ per annum. 8

Given :- at 6%

$\ddot{a}_{35} = 15.052$ $R_{35} = 516333.68$

$D_{35} = 126664.23$ $A_{35} = 0.14801$

b) Write only expression for :-

i) Retrospective Policy Value at the end of 30 years under a whole life policy for a sum assured of Rs. 10,000 effected on the life of a person at age 30. Annual premiums under the policy are limited to 25 years and the policy carries a guaranteed simple reversionary bonus of Rs. 25‰ vesting at the beginning of each policy year. 4

ii) Paid up value of a 25 year pure Endowment Assurance at duration 10 years from commencement of the policy. Age of life assured is 25 years. 4

c) A person as on today aged 30 has an Endowment Assurance Policy for Rs. 20,000 issued to him 10 years ago. Policy will be maturing at his age 55. Calculate the paid up value of this policy as on today using the following values. 4

Given :- at 6% :-

$\ddot{a}_{30:\overline{25}|} = 13.253$ $M_{30} = 19801.59$

$a_{20:\overline{35}|} = 15.067$ $M_{55} = 12716.28$

$D_{55} = 35573.26$ $D_{30} = 170763.39$

8. a) Establish algebraically relationship :- 4

$$l_{x+t}\,({}_tV_x + P_x) = d_{x+t} + l_{x+t+1}\;{}_{t+1}V_x$$

b) Why there is need to make provision for the reserve of lapsed policies at the time of valuation ? 4

c) Calculate the net annual premium under a children's Deferred Endowment assurance for Rs. 50,000 on the life of a child aged 3, the assurance vesting at age 18 and maturing at age 65. Calculate also the additional premium for the premium waiver benefit in the event of death of child's father aged 40 years. 12

Given :-

$\ddot{a}_{18:\overline{47}|} = 16.063$ $V^{15} = 0.41727$

$A_{18:\overline{47}|} = 0.0907$ $\ddot{a}_{\overline{15}|} = 10.2950$

$a_{40:\overline{15}|} = 10.029$

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