

**"QUESTION PAPER MUST BE ATTACHED ALONGWITH THE ANSWER BOOK."**

**CFL-81**

November, 2016

**MATHEMATICAL BASIS OF LIFE ASSURANCE**

Reg. No.

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[Time : 3 Hours]

[Total Marks: 100]

Answer **ANY FIVE** questions only. All questions carry **20** marks each.  
(Candidates are allowed to refer handbook on Formulae and Tables).

		<b>Marks</b>
Q.1.	a) State mathematical expressions for the paid up value in terms of annual premium chargeable as well as the assurance payable on the following, clearly giving the details of notations. (State two expressions for each type of policy)	5
	i) A whole life policy	
	ii) An n year Endowment assurance policy	
	b) Briefly describe the methods of allowing for an extra risk in life insurance and briefly explain the relationship between the two methods.	5
	c) Calculate the true monthly premium for a Whole Life Assurance of Rs.100000 on a life aged 50 years where the premiums are limited to a term of 10 years. Basis: IALM (94-96) Modified Ultimate Table and 6% interest rate	5
	d) Calculate the quarterly instalment of an immediate annuity payable in arrear for a person aged 52 years for 15 years certain and thereafter for life. The single premium for the annuity works out to Rs. 25000 after providing for expenses at Rs.15 per thousand single premium and 4% of the annuity instalments. Basis: LIC (a) 96-98 ultimate tables and 8% interest.	5
Q.2.	a) Calculate the net annual premium for Double Endowment Assurance for Basic Sum Assured of Rs.50000 on the life aged 35 years for a term of 20 years. Assume that the death benefit is payable immediately on death. Basis IALM (94-96) (Modified) Ultimate Table and 6% interest.	5
	b) Distinguish between two types of proportional reinsurance contract	5
	c) A life insurance company issues an annuity to a life aged 60 exact. The purchase price is Rs.200000/= The annuity is payable monthly in advance and is guaranteed to be paid for a period of 10 years and for the whole of life thereafter. Calculate the annual annuity payment. Basis: LIC(a) 96-98 Ultimate Interest: 8% per annum	5
	d) Describe the Valuation of Unit Linked Policies.	5
Q.3.	In recent times the asset shares have become useful tool in the financial management of conventional with profit life insurance business.	

- a) List the components of Asset Share of a typical life insurance policy. 5
- b) Determine mathematical expression of asset share and explain each item used in the expression. 6
- c) Describe the application of asset share in the management of the life insurance business. 9
- Q.4. a) Derive the relationship between policy values in successive years in respect of a whole life policy and briefly explain what does the above relationship indicate. 8
- b) Write short notes on the following: 12
- Currency Risk
  - Mortality Risk
  - Interest Rate Risk
  - Withdrawal Risk
- Q.5. You are an actuary with a small size life insurer with limited capital, which started its operations four years back. You are reviewing the financial condition of the insurer for the year ended 31st March, 2016. The insurer during the financial year 2015-16 has written significantly large business compared to last year.
- One of the Board members of the insurer on discussion with you commented." How the solvency position has deteriorated when the new premium growth has been significant."
- a) Discuss the possible reasons for deteriorating solvency position of the insurer. 6
- The Board member further observed that over 30% of the total new business premium is through single premium.
- b) Discuss with reasons why additional capital may be required for writing single premium policies. 6
- During discussions you informed the Board member about the mismatch of duration of assets and liabilities and their impact on the cash flow position with movement in interest rates.
- c) Discuss Asset Liability management for the insurer and its growing significance. 8
- Q.6. a) Describe the nature of various types of expenses of an insurer. 6
- b) Rewrite the following equation after allowing for the expenses as indicated below:
- $$P \ddot{a}_{x:n} = S A_{x:n} \quad (P: \text{Premium} ; S : \text{Sum assured})$$
- Initial acquisition expenses of 3% of the sum assured 2
  - Renewal expenses of 6% of each premium, including the first 2
  - Claim expenses of 1% of the sum assured 2
  - Initial expenses of 35% of first premium plus renewal expenses of 6% of each premium excluding the first. 2



	c)	A life insurer issues 2-year Temporary Assurance to a life aged 40 years. Calculate office single premium for sum assured of 50,000. Basis: Expenses at 5% of single premium and 2% sum assured. Mortality: IALM (94-96) modified ultimate Mortality Table and 6% interest.	6
Q.7.	a)	Write short notes on	
	i)	Mix of New Business by nature and size of contracts	4
	ii)	Paid up Values	4
	iii)	Alteration of policy Contracts	4
	b)	i) Explain Briefly on Contribution method of surplus Distribution	4
		ii) Write short notes on Terminal Bonus	4
Q.8.	a)	Derive an expression for a net premium per annum payable m times a year at the beginning of the each of the mth period of a year in respect of a whole life assurance of unit sum assured payable at the end of year of death on a life aged x.	4
	b)	A life insurance company issues the following policies: <ul style="list-style-type: none"> <li>• 25-year term assurances with a sum assured of Rs. 2,00,000</li> <li>• 25-year endowment assurances with a sum assured of Rs.1,00,000</li> </ul> The death benefit under each type of policy is payable at the end of year of death. On 1 <sup>st</sup> January 2000, the company sold 10,000 term assurance policies to male lives then aged 40 exact and 20,000 endowment assurance policies to male lives then aged 35 exact. For each type of policy, premiums are payable annually in advance. During the first ten years, there were 145 actual deaths from the term assurance policies written and 232 actual deaths from the endowment assurance policies written.	
	i)	Calculate the death strain at risk for each type of policy during 2010.	12
	ii)	During 2010, there were 22 actual deaths from the term assurance policies and 36 actual deaths from the endowment assurance policies. Assume that there were no lapses/withdrawals on each type of policy during the first eleven years. Calculate the total mortality profit or loss to the office in the year 2010. The basis is IALM (1994-96) Ultimate Mortality Table with 6% interest rate per annum. Ignore expenses.	4

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