# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

**B.Sc.** DEGREE EXAMINATION – **STATISTICS**

FIFTH SEMESTER – NOVEMBER 2015

**ST 5406 - ACTUARIAL STATISTICS**

Date : 13/11/2015 Dept. No. Max. : 100 Marks

Time : 09:00-12:00

**Section A**

**Answer ALL questions.** **(2 x 10 = 20)**

1. Define interest rate.
2. What is an annuity?
3. What are the various ways of redemption of loan?
4. What do you mean by a perpetuity?
5. Define discount.
6. Define stochastic interest rates.
7. What is the use of mortality table?
8. What is the principle of insurance?
9. What is a stationary population?
10. Define Endowment assurance.

**Section B**

**Answer any FIVE questions.** **(8 x 5 = 40)**

11. Mr. A promises to pay Mr. B a sum of Rs. 2000 at the end of 3 years and another Rs. 4000 at the end of 5 years from now. What immediate cash payment should Mr. B accept in lieu of the above payments, if interest is reckoned at 5% p.a.
12. Differentiate between effective and nominal rate of interest and derive the expressions for effective rate corresponding to nominal rate and vice-versa.
13. In lieu of a single payment of Rs. 1000 at the present moment a person agrees to receive three equal payments at the end of 3 years, 6 years and 10 years respectively. Assuming a rate of interest of 6% p.a., what should be the value of each of the three payments?
14. Explain deferred annuities and derive expressions for present value and accumulated value of deferred annuities.
15. Calculate the expected accumulated value at the end of 5 years of an initial investment of Rs. 50,000 if the returns from the investment are assumed to conform to the fixed interest rate model with the distribution of the following interest rates.

$$i_k = \begin{cases} 0.06 & with\ probability\ 0.2 \\ 0.08 & with\ probability\ 0.7 \\ 0.10 & with\ probability\ 0.1 \end{cases}$$

k = 1,2,3,4,5.

16. What is the object of constructing a mortality table? Give the general procedure and stages involved in the construction of mortality table.

17. Fill up the blanks in the following portion of a life table:

| **Age x** | $\mathbf{l_x}$ | $\mathbf{d_x}$ | $\mathbf{q_x}$ | $\mathbf{p_x}$ |
|---|---|---|---|---|
| 10 | 1000000 | | 0.00409 | |
| 11 | | | 0.00370 | |
| 12 | | | | 0.99653 |
| 13 | | | | 0.99658 |
| 14 | | | 0.00342 | |

18. An employee of an institution has to retire at age 55. A gratuity benefit of one month's salary for each year of service subject to a maximum benefit of 15 months' salary is payable to an employee on retirement or death. Find the probability that
    - **(i)** Full gratuity benefit will be payable to a person aged 30, who has just now completed 5 years of service.
    - **(ii)** The gratuity benefit payable will not exceed 10 months' salary
    - **(iii)** The gratuity benefit payable will be atleast 12 months' salary
    - **(iv)** The employee earns atleast 12 months' salary as a gratuity benefit payable at death.

## Section C

**Answer any TWO questions.** **(20 x 2 = 40)**

19. **(a)** Explain in detail the classification of annuities.

    **(b)** A series of 8 annual sums of money is payable, the first payment taking place at the end of one year from now. The first 5 payments are Rs. 3000 each and the last 3 payments are Rs. 2000 each. Find the present value and the accumulated value of the 8 payments at 8% p.a. **(12 + 8)**

20. A loan of Rs. 10,000/- is to be repaid with interest at 6% p.a. by means of an immediate annuity for 5 years. Find the level payment. Prepare a table showing the loan schedule. What will be the principal and interest contained in each of the 5 installments?

21. Explain $S_n$ and $A_n$ in the context of stochastic interest rates and derive mean and variance of $S_n$ and $A_n$.

22. **(a)** The following particulars are given:

| **X** | **25** | **26** | **27** | **28** | **29** | **30** |
|---|---|---|---|---|---|---|
| $\mathbf{l_x}$ | 97380 | 97088 | 96794 | 96496 | 96194 | 95887 |
| $\mathbf{d_x}$ | 292 | 294 | 298 | 302 | 307 | 313 |

Calculate allowing a rate of interest of interest of 6% p.a.

- **(i)** The value of temporary assurance of Rs. 10,000 for 2 years for a person aged 25.
- **(ii)** The value of endowment assurance benefit of Rs. 10,000 for 4 years for a person aged 25.

**(b)** Explain temporary assurance and endowment assurance and derive the expressions for their present values in terms of their commutation functions. **(8 + 12)**

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