# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

### B.Sc. DEGREE EXAMINATION – STATISTICS

FIFTH SEMESTER – APRIL 2017

### ST 5406/ST 5404- ACTUARIAL STATISTICS

Date: 02-05-2017            Dept. No.                    Max. : 100 Marks
01:00-04:00

## Section A

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

1. Define effective rate of interest.
2. What is a deferred annuity?
3. What are the various ways of redemption of loan?
4. What do you mean by 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. The cash purchase price of a motorcycle is Rs. 1,00,000, a company however offers installment plan where under an immediate payment of Rs. 20,000 is to be made and a series of 5 equal half yearly payments made thereafter, the first installment being payable at the end of six months. If the company wishes to realize a rate of interest of 12% convertible half-yearly in the transaction, calculate the half-yearly installment.

12. Derive the expressions for effective rate of interest corresponding to nominal rate of interest 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.** A company considers that on average it will earn interest on its funds at the rate of 4% pa. However, the investment policy is such that in any one year the yield on the company's funds is equally likely to take any value between 2% and 6%. For a single premium accumulation with term of 10 years at an investment of Rs. 1000, find the mean accumulation and the standard deviation of the accumulation at the maturity date.

**16.** Explain in detail the various columns of a mortality table and the probabilities of survival and death.

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

| Age x | $I_x$ | $d_x$ | $q_x$ | $p_x$ |
|-------|---------|-------|---------|---------|
| 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 exactly 12 months' salary

## 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 8% 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 $S_n$ (accumulation of a single investment) and $A_n$ (accumulation of a series of annual investments) 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 |
|---|---|---|---|---|---|---|
| $I_x$ | 97380 | 97088 | 96794 | 96496 | 96194 | 95887 |
| $d_x$ | 292 | 294 | 298 | 302 | 307 | 313 |

Calculate allowing a rate 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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