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(July)

MATHEMATICS

(Honours)

(Financial Mathematics)

(HOPT-62 : OP4)

Marks : 75

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. (a) What is the main difference between simple and compound interests? Show graphically how a simple interest and a compound interest grow for a ₹ 10,000 investment at 10% per annum in 7 years time. 2+8=10

- (b) Suppose that you have the opportunity to plant trees that later can be sold for lumber. No cash flow occurs until the trees are harvested. However you have a choice as to when to harvest; after one year or after two years. Assuming that the cash flow streams associated with these two alternatives are (1, 2), if cut early and (1, 0, 3), if cut later and also assuming that the prevailing interest rate is 10%, find the associated net present values. 5

2. (a) You are contemplating the purchase of an automobile and have narrowed the field down to two choices. Car A costs ₹ 2 lakhs, is expected to have a low maintenance cost of ₹ 10,000 per year (payable at the beginning of each year after the first year), but has a useful mileage life that for you translates into 4 years. Car B costs ₹ 3 lakhs and has an expected maintenance cost of ₹ 20,000 per year (after the first year) and a useful life of 6 years. Neither car has a salvage value. The interest rate is 10%. Which car should you buy? 10

- (b) Explain what you mean by risk aversion principle of investment. Give an example to illustrate your argument.

2+3=5

UNIT—II

3. (a) If a bank promises to pay a rate of s_2 for a 2-year deposit of an amount A compounded half-yearly, how much will the money grow at the end of 2 years? 4
- (b) What do you mean by the term 'convexity'? What are its uses? 2+3=5
- (c) Consider a 10%, 30-year bond, if it is selling at par, calculate the current yield. If the same bond were selling for 90, what would be the current yield and the yield to maturity? 6
4. (a) Prove that the value of a floating rate bond is equal to par at any reset point. 8
- (b) Consider a 7% bond with 3 years to maturity. Assume that the bond is selling at 8%. Find the value and the Macaulay duration. 7

UNIT—II

5. (a) Explain the following terms : 4+4=8
- (i) Rate of return of an asset
- (ii) Short selling of an asset

- (b) Suppose I decide to short 100 shares of stock in company CBA . This stock is currently selling for ₹ 100 per share. I borrow shares from my broker and sell these in the stock market, receiving ₹ 10,000. At the end of 1 year, the price of CBA has dropped to ₹ 90 per share. I buy back 100 shares for ₹ 9,000 and give these shares to my broker to repay the original loan. Determine how much profit I made in this transaction. 7
6. (a) What do you mean by the following terms? 4+4=8
- (i) Capital market line
- (ii) Price of risk
- (b) Mr. Smith is young and impatient. He notes that the risk-free rate is only 6% and the market portfolio of risky assets has an expected return of 12% and a standard deviation of 15%. He figures that it would take about 60 years for his ₹ 1,00,000 nest egg to increase to ₹ 10,00,000 if it earned the market rate of return. He can not wait that long. He wants that ₹ 10,00,000 in 10 years. Will he be successful in achieving the amount in the stipulated time? Explain. 7

(5)

UNIT—IV

7. (a) Suppose an asset can be stored at zero cost and also sold short. Suppose that the current spot price (at $t = 0$) of the asset is S . Determine the theoretical forward price for delivery at $t = T$. 10
- (b) What is 'hedging'? Explain through an example. 5
8. (a) Discuss how well the multiplicative model of lognormal prices fits actual stock price behaviour. 10
- (b) Describe the meaning of a binomial tree by means of an example. 5

UNIT—V

9. (a) Mention the different types of general insurance. What is the meaning of loss? 5+2=7
- (b) Suppose that Mr. Smith takes a long position of contract in corn (5000 bushels) at a price of ₹ 2.10 (per bushel) and suppose that the broker requires margin of ₹ 800 with a maintenance margin of ₹ 600. The next day the price of the contract drops to ₹ 2.07. The following day the price drops again to ₹ 2.05. Determine the losses. What is an alternative for Mr. Smith not to give up his contract? 8

(6)

10. (a) What do you mean by premium of a life insurance? What are the benefits of a life-insurance? 2+3=5
- (b) Mr. Jones is planning to invest \$ 1 million in a rock concert to be held 1 year from now. He figures that he will obtain \$ 3 million revenue from his \$ 1 million investment unless, it rains. If it rains, he will lose the entire investment. Someone suggests that he buys one unit of insurance for \$50 and this unit pays \$ 100 if it rains and nothing if it does not. He may purchase as many units as he wishes up to \$ 3 million. Determine the expected rate of return on his investment if he buys n units of insurance. 10
