



## Avinashilingam Institute for Home Science and Higher Education for Women

Deemed to be University Estd. u/s 3 of UGC Act 1956, Category A by MHRD (now MoE)

Re-accredited with A++ Grade by NAAC. CGPA 3.65/4, Category I by UGC

Coimbatore - 641 043, Tamil Nadu, India

### Master's Degree Examination – May 2025 II Semester

Class : I P.G.  
Major : Mathematics

Time: 3 Hours  
Max. Marks: 100

#### 23MMAC11 Mathematical Finance

##### Course Outcomes:

- CO1: Understand financial markets and derivatives including options and futures  
CO2: Know about the concept of bonds and derivatives  
CO3: Appreciate pricing and hedging of options, interest rate swaps and no-arbitrage pricing concepts  
CO4: Learn stochastic analysis and the Black–Scholes model  
CO5: Study and use Hedging parameters, trading strategies and currency swaps

#### Part A Choose the Correct Answer

10 x 1 = 10

- The general rule for simple interest is that if an amount  $A$  is left in an account at simple interest  $r$ , the total value after  $n$  years CO1K1  
a.  $V = (1 + rn)A$     b.  $V = (1 - rn)A$     c.  $V = (1 + rn)$     d.  $V = (1 + r)A$
- \_\_\_\_\_ = (Present value of the benefits) – (The present value of the costs). CO1K1  
a. Present worth    b. Net Present Value    c. Net Amount    d. Internal Rate
- \_\_\_\_\_ are the basic interest rates defining the term structure. CO2K2  
a. Yield curve    b. Forward rate    c. Spot rates    d. Term
- The payoff from a long position in a forward contract on one unit of an asset is CO2K2  
a.  $S_T$     b.  $S_T K$     c.  $S_T + K$     d.  $S_T - K$
- A lower bound for the European call option on a non-dividend paying stock is CO3K1  
a.  $s_0 - Ke^{-rT}$     b.  $s_0 - e^{-rT}$     c.  $s_0 + Ke^{-rT}$     d.  $s_0 + e^{-rT}$
- It is \_\_\_\_\_ optimal to exercise an American call option on a non-dividend-paying stock before the expiration date. CO3K2  
a. never    b. always    c. sometimes    d. unnecessary
- The delta of a call option is CO4K1  
a. negative    b. positive    c. zero    d. one
- The mean of the return in time is CO4K2  
a.  $\nabla t$     b.  $\Delta t$     c.  $\mu \Delta t$     d.  $\Delta \mu t$
- A \_\_\_\_\_ is an over-the-counter agreement between two companies to exchange cash flows in the future. CO5K1  
a. theta    b. spread    c. swap    d. vega
- Static hedging is also referred to as CO5K2  
a. dynamic hedging    b. delta neutral    c. hedge and forget    d. Merton Analysis

**Part B**

**5 x 6 = 30**

**Answer ALL questions**

**Each answer should not exceed 400 words or two pages**

- 11.a. The purchase of a new machine for Rs. \$100,000 is expected to generate additional revenues of \$25,000 for the next 10 years starting at year 1. If the discount rate is 16%, is this a profitable investment? CO1K2
- (or)
- 11.b. An 8% bond with 18 years to maturity has a yield of 9%. What is the price of this bond? CO1K2
- 12.a. Consider a stock that pays no dividend and is worth \$60. You can borrow or lend money for 1 year at 5%. What should the 1-year forward price of the stock be? CO2K2
- (or)
- 12.b. Write the forward rate formulas. CO2K3
- 13.a. Write about the factors affecting the option prices. CO3K3
- (or)
- 13.b. Write about lower bound for calls and puts. CO3K2
- 14.a. Write down the assumptions used to derive the Black-Scholes-Merton differential equation. CO4K2
- (or)
- 14.b. Explain the distribution of the rate of return. CO4K3
- 15.a. Write about the relationship between Delta, Theta and Gamma. CO5K3
- (or)
- 15.b. Explain the strips and straps. CO5K2

**Part C**

**5 x 12 = 60**

**Answer ALL questions**

**Each answer should not exceed 800 words or four pages**

- 16.a. Find the corresponding rates for: CO1K3
- i. 3% compounded monthly
  - ii. 18% compounded monthly
  - iii. 18% compounded quarterly
- (or)
- 16.b. Find price and duration of a 10-year, 8% bond that is trading at a yield of 10%? CO1K4
- 17.a. State and prove invariance theorem. CO2K3
- (or)
- 17.b. Given the yearly spot rate curve  $s = (50,53,56,58,60,61)$ . Find the spot rate curve for next year. CO2K4
- 18.a. Explain the lower bound for European puts on non-dividend paying stocks. CO3K3
- (or)
- 18.b. What is a lower bound for the price of a one month European put option on a non-dividend paying stock when the stock price is \$12, the strike price is \$15, and the risk-free interest rate is 6% per annum? CO3K3

19.a. Explain the derivation of the Black-Scholes-Merton differential equation. CO4K3

(or)

19.b. Explain the Lognormal property of stock prices. CO4K4

20.a. Consider a call option on a non-dividend paying stock where the stock price is \$49, the strike price is \$50, the risk-free rate is 5%, the time to maturity is 20 weeks and the volatility is 20%. Find the increase in the value of a option by THETA of the portfolio. CO5K3  
( $s_0 = 49, k = 50, r = 0.05, \sigma = 0.2$  and  $T = 0.3846$ )

(or)

20.b. Consider a call option on a non-dividend paying stock where the stock price is \$49, the strike price is \$50, the risk-free rate is 5%, the time to maturity is 20 weeks and the volatility is 20%. Find the increase in the value of a option by VEGA of the portfolio. CO5K4  
( $s_0 = 49, k = 50, r = 0.05, \sigma = 0.2$  and  $T = 0.3846$ )

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