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2143

Your Roll No.

B.Sc. (Hons.) / III

C

MATHEMATICS – Paper XII (iii)

Mathematical Finance

(Admissions of 2009 and onwards)

Time 3 Hours

Maximum Marks : 75

*(Write your Roll No. on the top immediately
on receipt of this question paper.)*

Attempt any two parts from each question.

All questions carry equal marks.

Use of scientific calculator is allowed.

(a) Define the term arbitrage. How much profit can be made by borrowing Rs. 10,000 at 10% rate of interest per annum and lending the same at the same rate of interest compounded (i) half yearly (ii) quarterly ?

(b) What is internal rate of return of a cash flow stream ? Which of the following cash flow streams (A) or (B) is recommended on the basis of internal rate of return :

(A) $(-1, 2)$ (B) $(-1, 0.3)$

(c) Calculate the EMI (estimated monthly installment) of the following loan arrangement :

Loan Amount Rs. 5,00,000

Total Time 10 years

Rate of Interest 12% p.a.

Compounding Monthly

P.T.O.

Assume the repayments are made at the end of every month.

2. (a) Explain the term accrued interest in reference to a bond sold in the market at a time in between two coupon payments. Calculate the accrued interest for the following bond :

<u>Face Value of bond</u>	Rs. 100
<u>Coupon Rate</u>	9% p.a. paid half yearly
<u>Date of Sale of bond</u>	8 th May
<u>Date of Last Coupon Payment</u>	15 th February
<u>Date of Next Coupon Payment</u>	15 th August

- (b) What do the various symbols stand for in the following bond price formula ?

$$P = \frac{F}{\left(1 + \frac{\lambda}{m}\right)^n} + \frac{C}{\lambda} \left[1 - \frac{1}{\left(1 + \frac{\lambda}{m}\right)^n}\right]$$

Should the price be higher or lower if the yield is higher ?

- (c) Define the term spot rate. The 1-year spot rate is 10% per annum. Find the 2-year spot rate if the market price of a 2-year bond having face value of Rs. 100 and 10% coupon rate is Rs. 90.
3. (a) What do you mean by short selling an asset ? A person short sells 100 shares of a company being traded at Rs. 60 per share on 1st July 2011 and squares his position by repurchasing the same at

Rs. 50 per share on 30th June 2012. What is his profit and rate of return ?

- (b) A person simultaneously rolls a die and tosses a coin. He receives an award in rupees equal to the number on the die, besides that he receives Rs. 5 for a head on the coin whereas penalized Rs. 5 for a tail. What is his expected reward and the standard deviation ?
- (c) A person invests 30% and 70% of his savings in stocks A and B respectively. The expected returns of A and B are respectively 0.10 and 0.16 whereas standard deviations are 0.15 and 0.25, and 0.04 is the covariance between the two. Find his expected rate of return and standard deviation on the investment.

4. (a) Define the term derivative security. What are the differences between a forward contract and a future contract ?
- (b) Consider an asset that does not provide any income to its holder, can be stored at zero cost and also sold short. Find the forward price F of a forward contract on this asset with delivery time T .
- (c) Suppose that a financial institution has agreed to pay 6-month LIBOR and receive 8% per annum (with semiannual compounding) on a notional principal of Rs. 100 million. The swap has a remaining life of 1.25 years. The LIBOR rates with continuous compounding for 3-month,

9-month, and 15-month maturities are 10%, 10.5% and 11% respectively. The 6-month LIBOR rate at the last payment date was 10.2% (with semiannual compounding). Find the value of the swap to the financial institution by regarding the swap as the difference between two FRAs.

5. (a) Define the term options. What is the difference between a European option and an American option?
- (b) Explain why it is not optimal to exercise an American call option on a non-dividend-paying stock before the expiration date.
- (c) A stock price is currently Rs. 20. Over each of the next two 3-month periods it is expected to go up by 10% or down by 10%. The risk free interest rate is 12% per annum with continuous compounding. Using a two-step binomial tree, find the value of a 6-month European call option with a strike price of Rs. 21.
6. (a) Find the payoff from a bear spread created using call options. Also draw the profit diagram corresponding to this trading strategy and comment on the view about the market this strategy express.
- (b) Derive the put-call parity for European options on a non-dividend-paying stock.
- (c) Using the above put-call parity, derive the relationship between the delta of a European call and delta of a European put on a non-dividend-paying stock.